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Methods for the Determination of Chemical Contaminants in Drinking Water

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16. ABSTRACT

This handbook is designed for use by instructors who will have to teach others how to perform National Interim Primary Drinking Water Regulation (NIPDWR) analyses. It is to be used in conjunction with the participants handbook bearing the same title (EPA-430/1-80-006). It includes topics related to the presentation of training courses in which the analyses are to be taught. These topics include: examples of course announcements, agendas, registration procedures, and records; consideration of staff, equipment and facilities required to conduct the training. There are Instructor Lesson Plans containing details about presenting instruction for each analysis. Pre- and Post-tests and student feedback forms are also included.

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Methods for the Determination of Chemical Contaminants in Drinking Water

Instructors Handbook

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INSTRUCTORS HANDBOOK

METHODS FOR THE DETERMINATION OF CHEMICAL CONTAMINANTS IN DRINKING WATER

This manual was developed in the Environmental Protection Agency by the National Training and Operational Technology Center with the Technical Support Division in response to a request from the Office of Water Supply.

National Training and Operational Technology Center
Municipal Operations and Training Division
Office of Water Program Operations
U. S. Environmental Protection Agency

DISCLAIMER

Reference to commercial products, trade names, or manufacturers is for purpose of example and illustration. Such references do not constitute endorsement by the Office of Water Program Operations or the Office of Water Supply, U. S. Environmental Protection Agency.

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INTRODUCTION TO INSTRUCTORS MANUAL

The purpose of this manual is to assist the instructor/s who will be teaching this course. The Interim Primary Regulations have set down which parameters will be analyzed for and how they will be analyzed. When the regulations are revised this manual will be revised. Until then the methodology for analysis is set. The attached table shows the materials which must be analyzed and the prescribed methods. Some of the methodology is under revision at this time by requests for alternate test procedures. In point is the analysis of inorganic parameters via the furnace techniques of atomic absorption. In anticipation of their approval these techniques are to be included.

This course and accompanying manuals have been designed to allow you maximum flexibility. Units have been written for all methods. You may choose which you will include.

All method units have been written in a format which will facilitate student use in the laboratory. The step-by-step format will allow the student to work along as he reads the procedure and still be given additional helpful comments about the procedure. In some instances, the gas chromatographic techniques, it must be assumed that a higher level technician or a professional person both with some background in the technique will be doing the analysis. To write the procedures for a person with no experience in gas chromatography would necessitate covering all the basic techniques which is beyond the scope of this manual.

It has been assumed that anyone taking this course has the necessary basic laboratory skills. If in your precourse analysis of the students you determine that an individual does not have these skills it would be best if these skills are acquired before they take this course. If not, the instructor will spend more time teaching these skills than the methodology this course was designed to cover.

A suggested checklist that could be used to give you an indication of the student's basic skills have been included here. It can be seen that if these skills are not possessed, then teaching a subject as advanced as Atomic Abosrption will be extremely difficult. If you have prior knowledge of the students background, the use of this list may not be necessary.

The duration of this course is again a choice you have as the instructor or director of this course. The choices run from a week long combined organic-inorganic course to cover some parameters to a single night session running over a period of time. (See D for examples.) Each unit could become a topic for a night session.

These choices allow you to tailor the course to fit the needs of the participants. One suggestion, it is a good idea to include in the course a laboratory session for each parameter unit taught. A student tends to learn faster and retain longer skills learned in a hands-on environment.

Another recommendation is to have the laboratory session follow as closely as possible after the lecture session on a topic. This allows the student to draw on what has been covered. This way the laboratory session acts as a reinforcement of what the student has already been told.

Contaminants as Listed in the National Interim Primary Drinking Water Regulations

Contaminant	Method
Inorganic	
Arsenic	Atomic Absorption-Gaseous Hydride Method
Barium	Atomic Absorption-Direct Aspiration
Cadmium	Atomic Absorption-Extraction and Concentration
Chromium	Atomic Absorption-Extraction and Concentration
Lead	Atomic Absorption-Extraction and Concentration
Mercury	Atomic Absorption-Flameless Technique
Nitrate	Colorimetric-Cadmium Reduction Method Colorimetric-Brucine
Fluoride	Electrode Method Colorimetric-SPADNS after Distillation
Selenium	Atomic Absorption-Gaseous Hydride Method
Silver	Atomic Absorption-Direct Aspiration
Organic	
Chlorinated Hydrocarbons	Extraction followed by Gas Chromatography
Chlorophenoxy's	Extraction followed by Gas Chromatography

Name ______________________________

Employer ___________________________

STUDENT SKILLS CHECKLIST

To assist us in processing applications, please check YES or NO for each of the following items:

	YES	NO
I have operated a laboratory gas burner	____	____
I have operated a laboratory hotplate/stirrer	____	____
I have operated an autoclave	____	____
I have operated a laboratory drying oven	____	____
I have used a vacuum source to filter liquids	____	____
I have used a desiccator	____	____
I have weighed items on an analytical balance	____	____
I have weighed items on a double pan balance	____	____
I have used a graduate to measure liquids	____	____
I have used a volumetric pipet to measure liquids	____	____
I have used a graduated pipet to measure liquids	____	____
I have used a pipet bulb to fill a pipet	____	____
I have used mouth suction to fill a pipet	____	____
I have used an inoculating loop to transfer small amounts of liquid	____	____
I have used disinfectant to sterilize a lab bench work area	____	____
I have poured liquid from a container into glass test tubes	____	____
I have prepared media used for coliform tests	____	____
I have used chromic acid to clean glassware	____	____
I have operated a laboratory safety shower	____	____
I have operated a laboratory eye washer	____	____
I have operated a fume hood	____	____
I have prepared manganous sulfate solution	____	____
I have made out labels for bottles or reagents	____	____
I have used a buret	____	____
I have used starch as a chemical change indicator	____	____
I have titrated one solution against another to a color change end Point	____	____
I have recorded a reading at a meniscus	____	____
I have recorded laboratory data in a laboratory notebook	____	____
I have entered laboratory data on a pre-printed form	____	____
I have recorded information about samples on record sheets	____	____
I have located required purchase information in a catalog of laboratory equipment	____	____
I have written a purchase order for chemicals to be used in the lab	____	____

Name ______________________________

Employer ___________________________

	YES	NO
Volume means space occupied by a solid, liquid, or gas	___	___
mg/l means milligrams per liter	___	___
Normality (N) is a way to express concentration in a solution . .	___	___
1 kilogram equals 0.001 gram	___	___
1 inch equals 2.54 cm	___	___
1000 ml equals 1 liter	___	___
85 times 4.1 equals 42.5	___	___
7 minus 2 divided by 0.02 equals 250	___	___
3.26 rounded to the nearest tenth is 32.6	___	___
84.55147 rounded to the nearest thousandth is 84.551	___	___

PRE-COURSE ACTIVITIES

INTRODUCTION

It is assumed that prior to presentation of any course there are a number of activities and preparations an instructor must complete. The following tabs and their contents are included to aid you in gearing-up for this course. Each item is accompanied by an appropriate explanatory note. We hope you find these aids useful.

One of the most important pre-course activities is course planning. This should begin the minute it is decided to offer a training course. This becomes more important as the more complex a course becomes to offer. The person in charge of the course, the Course Director, needs to consider the resources at his command. For example, he should consider the amount of administrative equipment, such as the room and the laboratory, projectors, chairs, etc. Can he, for example, reserve both a classroom and a laboratory for an entire week just for course use? He should consider the scientific equipment available, such as glassware and instruments. Having the student standing around waiting to use a balance is not a good idea. If he intends to split the class into half and present two laboratory sessions, one to each half, does he have another instructor and sufficient equipment?

Not only should equipment be considered, but also manpower. The instructional staff should be large enough to allow someone to be with the students at all times. This means that if there is only one instructor, who will change the laboratory over to meet the needs of the next session? Who will make up the reagents if they are not stable enough to be made up ahead of time?

Also connected with this same planning idea is the need to consider both upper and lower limits to the number of students in the class. The student to instructor ratio is critical to the successful offering of a course. Ultimately a small number of students to instructor ratio is best, but some concession to this must be made. Perhaps the equipment or room space will help the instructor decide the student limit. An instructor should also consider whether sufficient secretarial and technical help is available.

I. Announcing the Course

A. Course Availability

This course can be offered at both the Federal and the State levels. The National program may wish to offer the course on a regular basis as a form of technical assistance to those laboratories that might request aid in learning how to carry out certain analytical procedures. It could also be used by laboratory personnel, if the laboratory, upon being visited for certification purposes, is found to need assistance.

The chemists in the State principal laboratory might wish to attend the course in order to keep current on changing types of analysis and different methods that have been approved under alternate test procedures, particularly if the State has elected to do the analyses required under the Safe Drinking Water Act instead of using private laboratories.

The State using private laboratories might wish to offer this course in order to assure that all laboratories are carrying out analysis via acceptable methodology and also as a form of technical assistance to those laboratories.

New persons in laboratories, as well as those technical persons assigned to carry out new and unfamiliar types of analysis, and also the certification personnel themselves might wish to take this course.

The course may be planned by a training organization in conjunction with the State or Regional laboratory and utilizing participation by the responsible Certification Officers. It would be the responsibility of the authority presenting the course to announce it to prospective students. All training organizations should establish and maintain mailing lists of officials, organizations and any interested persons to whom training announcements should be mailed. The certification authority should always be contacted just prior to any announcement of this course for suggestions on laboratories and/or persons to whom announcements should be mailed. When a special course offering is planned at the request of some authority with identified class participants, it is usually best for that requesting authority to make the announcement mailings.

Certain student biographic information is needed by the Course Coordinator. Regardless of how the students are enrolled or selected, this information should be obtained from some source. The example application for (Tab C2) can be used to obtain this information. If the State/Region assigns all trainees the information should be provided by this organization or by the employer of the trainee.

B. How Announced

1. Training bulletins, or catalogues are widely used by established training organizations, and should be used for announcement of this course when offered as part of an ongoing curriculum of courses.

2. Special fliers, or brochures, should be developed for public announcement through established mailing lists. These releases may be used for regular offerings of an ongoing curriculum of courses; but they are particularly applicable when a special offering of the course is planned.

3. The course may be announced in a journal, newsletter, or other periodical widely read by the personnel for whom the training is intended.

4. The course may be announced by personal letter or other direct communication with a student assigned to take the training.

C. When Announced

Training catalogues or bulletins usually are for a period of one year or more. Accordingly, the prospective student should have from three months to one year of advance notice of the training.

When the course is a special offering, announced through a flier or other special mechanism, at least 90 days should be provided between release of the announcement and the start of the course. There are at least two reasons for this:

1. Permits course applicants to secure necessary approvals for attendance, to make personal scheduling arrangements; and,

2. Provides course presentation staff with lead time for course preparations, acquiring special instructional materials, preparation of laboratory supplies and equipment, and related tasks.

D. Information provided in Course Announcement

The following list should be helpful as a checklist to those preparing a course announcement. Samples of an announcement for this course as it might appear in a special flier, and as it might appear in a catalogue of courses, are shown in the section of this Guide titled SECRETARIAL PREPARATIONS.

In the event that the course is announced in a periodical, the editor may apply constraints on style and format which make it impossible to provide all the pertinent information on the course. In such cases, the announcement must provide the name and address of an office from which further information can be obtained. The information to be provided should be as complete as that given in a course flier or catalogue and, naturally, should include any additional special information specifically requested.

The following identification of contents of a course announcement will be helpful as a checklist to those preparing an original course announcement:

1. Course title
2. Dates and location
3. Name of organization counducting the course (and name of co-sponsor, if applicable)
4. Description of intended student body
5. Reason why this training is needed
6. Identification of knowledge and skills the participant will have on satisfactory completion of training
7. Description of the training environment to be used (classroom, laboratory, field, in-plant, etc.)
8. Prerequisites for attendance (identificaiton of special knowledge and skills, or completion of other training, which the applicant must have for admission to this course)
9. Tuition (if applicable)
10. How and where to apply for admission to this course.

II. Course Milestones

The following pages list individual responsibilities in chronological order for preparation for this course.

The ultimate list of topics for this course will be the responsibility of the course director-coordinator. Each director will see needs specific to his particular case. Suggestions and modifications have been included in the design of this course for the information of the course director. The director should review this manual for the options included, using this manual as a core, design it to fit his specific needs.

Depending on the size of the training facility offering this course, the responsible person may have to seek assistance from outside his own group. The milestones chart lists the job titles for each instructional unit. It will be obvious that some individual job titles will be non-existent for a particular training facility and an individual may have multiple responsibilities when referring to this list. Also, as shown here, individuals with certain professional backgrounds are given primary responsibilities for certain units of instruction. Again, this may not be the case for the staff personnel at the training facility. The job titles should convey the following:

Administrator: a person having a responsible position in and who is familiar with the entire Drinking Water Program within the authority.

Chemical Certificaton Officer: the designated chemist who is in charge of evaluating any laboratory requesting certification from the authority.

Chemist: a person whose responsibilities, formal training, and experience is in the area of analytical chemistry.

Course Coordinator: the individual, regardless of background, who has been assigned the overall responsibility for presentation of the course.

Course Secretary: the individual who has been assigned the responsibility of assisting the course coordinator in all clerical, registration, record keeping, and related functions.

Since this course is 95% chemistry, all lectures and laboratories should be presented by a chemist who has actual experience with the method being considered. The topics listed below can be exceptions:

Outline No.	Title	Position Description
1	Regulations Concerning the SDWA	Administrator
2	Federal/State Role in the Act	Administrator
All Others		Chemist

MILESTONE CHART	Training Supv.	Course Coordinator	Course Secretary	Chemist	Certification Ofcr.	Administrator	Completed by	Remarks
5 to 6 Months before Course								
Determine need and decide to have course.	X							
Designation of Course Coordinator and Secretary.	X							
Development and release of course announcement (See Example, Tabe C2.)		X	X					
Course registrations received and accepted from time of announcement to first day of course, subject to class size limitations.		X	X					Coordinator reviews application form and forwards to Secretary for appropriate action.
Mail letters of invitation to student as they are approved.			X					
3 Months before Course								
Commit all staff personnel who will participate in course.	X	X	X	X	X	X		
Review equipment and supply needs for items which may be purchased or borrowed.		X	X	X	X			Professional staff initiates requests through coordinator.
Inventory of course manual.			X					Supplies should be adequate for each trainee and staff member.
2 Months before Course								
Request equipment and supplies from suppliers.		X	X	X	X			Professional staff initiates requests through coordinator--should be received at least one week before course and checked when received.

MILESTONE CHART

	Training Supv.	Course Coordinator	Course Secretary	Chemist	Certification Ofcr.	Administrator	Completed by	Remarks
3 Weeks before Course								
Capital equipment operational check								
Consult Capital Equipment lists, Tab C-4.		X		X	X			If any analytical methods are to be demonstrated or used in any way, the method outline should be consulted for equipment and reagents. These should be obtained now.
Consult Reusable Supplies lists, Tab C-4.		X		X	X			
Consult Facilities Needs Lists, Tab C-4.		X		X	X			
Obtain Information Needs. Consult List B, Tab C-4.		X		X	X			
Send participant manual to students.		X	X					
Include who, when and where, Tab C-2.		X	X					
Include Pre-Test, Tab C-1.		X	X	X	X	X		Coordinator may wish to reserve pre-test for first day of course.
Include Biographic Statement, Tab C-3.		X	X					
Include Participant Survey, Tab C-3.		X	X					
Include Pre-course reading material.		X	X	X	X	X		Entire staff should be consulted for material.
Reserve classroom and laboratories.		X	X					

MILESTONE CHART	Training Supv.	Course Coordinator	Course Secretary	Chemist	Certification Ofcr.	Administrator	Completed by	Remarks
3 to 1 Day before Course								
Course material								
Handout material (if any)		X	X	X	X	X		Can be given by individual instructors if desired.
Registration cards (see example)			X					
Classroom inspection and preparation								
Seating arrangements		X	X					
Equipment:		X	X					
PA System Blackboards Flip charts Projection equipment (operation back-up, spare bulbs) Overhead 2 x 2 16 mm								
Electrical system:								
Lighting Dimmer circuits Recepticles Recording Equipment								
Assemble all equipment in appropriate laboratories		X		X	X			
Have staff meeting to plan laboratory certification		X	X	X	X	X		

MILESTONE CHART	Training Supv.	Course Coordinator	Course Secretary	Chemist	Certification Ofcr.	Administrator	Completed by	Remarks
1st Day of Course								
Collect registration cards.			X					
Prepare roster.			X					
4th Day of Course								
Review trainee list as to those eligible to receive end-of-course certificate. Complete certificates as to content and signatures. (See example.)	X	X	X	X	X	X		
Pass out critique sheets to trainees for overnight consideration. (See example.)		X						
5th Day of Course								
Collect critiques.		X						
Pass out certificates	X	X						
Explain Tab G		X						
Clean up classroom and laboratories.		X		X	X			

III. Resources

This course requires manpower, equipment, and space resources. The rotating laboratory periods attempts to reduce the investment in equipment needs by placing fewer students in each laboratory, but actually increases the manpower and space requirements. The Course Coordinator must balance his needs against what is available.

Usually one single chemist could not be familiar with all the methods that are included. Consequently, the Course Coordinator should attempt to induce assistance from a laboratory section to provide this needed manpower.

Capital equipment such as atomic absorption units and gas chromatographs will need to be borrowed or used in the laboratory where they are used by research or analytical laboratory personnel. If budgets allow, the possibility of rental could be investigated.

For the first several offerings the number of students should be held to 16 or 20 individuals. If the rotating laboratories are used, this would mean 8 or 10 per laboratory and if they worked in pairs, 4 or 5 pieces of major equipment would be needed.

A. Training Staff

The staffing guide has been developed utilizing a staff of 7 or 8 individuals. It is realized that not all training facilities are so staffed. The Course Coordinator can double as one of the staff members, for example, one of the chemists. However, since his duties require time during the course for other things his lecture/laboratory duties should be kept low. The chemists inorganic-organic could be the same individual, however, this person would have to be familiar with all the methods. This would also present another difficulty if rotating laboratories are used. Consequently, there should be at least two chemists with some kind of backup, possibly experienced technicians, to carry out the laboratory sessions. The Certification Officer could also be one of the chemists and indeed this would be advisable that he/she participate throughout the entire course. However, if other duties will not allow this he should participate as shown in the staff identification section. The Administrator will probably come from outside the training staff and possibly not a chemist, so for this reason their participation has been kept at a minimum.

The Course Coordinator must know what resources are available and balance this against the need. The work responsibilities are spelled out as if each member listed is a separate individual. Consequently, if someone doubles as more than one of the identified participants, the responsibilities will be additive.

Each member of the training staff for this, as for any short course, is a member of a team. This team can function effectively only through each member's understanding of the training goals to be met, the plans for meeting these goals, through performance of his/her own duties, and through providing mutually supportive activity with other team members for the effective conduct of the course as a whole.

Each member of the instructional team should:

1. Have thorough knowledge of the subject matter for which he/she has responsibility, including a high order of technical skill in any procedures to be carried out;

2. Be able to perform effectively as an instructor, both in the classroom and in the laboratory. This includes ability to make rapid adjustments in the style and technical level of instruction in order to work with students having a varied range of entry-level knowledge, skills, and prior eduction; and

3. Be willing to accept a certain rigidity in the choice of analytical procedures to be taught, in accordance with policies and formal directives of the applicable regulatory authority.

Each member of the training staff has specific duties during, before, and after the scheduled course dates. For planning purposes, it is assumed that pre-course activity will begin three months or more, as required, before classroom instruction begins (see the miletsones section). During this period, the estimated time allocations will permit the phasing-in of work activity for this course with other duties of all personnel. During the course, individual members of the staff will be occupied for a great amount of their time as shown below. The times for the chemists are as assigned, where no specific type chemist is required and could be handled by any of the chemists, the time is shown under "chemist." Post-course activities should be completed within one or two weeks after the last day of instruction. In the post-course period, all staff may begin to phase in other duties pending final completion of all details associated with the course.

STAFF IDENTIFICATION: For the Combined Agenda	WORKING DAYS (Estimated)		
	Before	During	After
Course Coordinator (1) (can also be one of the staff)	12	5	2
Course Secretary (1)	10	2	2
Chemist (2)			
Inorganic (1)	12	5	1
Organic (1)	12	5	1
Certification Officer (1) (can be one of other staff)	1	1	
Administrator (1) (can be one of other staff)	1	1	
Laboratory Assistant (1) (optional)	10	5	5

The duties of each member of the staff have been listed below:

1. Course Coordinator

This individual may be known variously as Course Director, Course Leader, or by some other term suitable to the situation. In principle, any one of the instructors could function as Course Coordinator. In the absence of other factors, it may be best to have the individual who bears the lightest teaching load to act as Course Coordinator. Orginarily, the instructor designated as Certification Officer will have the lightest teaching load. However, if this individual substitutes as one of the chemists he should not be given the additional responsibilities of the Course Coordinator.

Before the course, the Coordinator receives assignment from management to lead the course, after which he/she:

a. Obtains commitment of the other members of the training team for the course, including secretary, instructors, and (if used) laboratory assistant.

b. Determines the composition and geographic origin of the student body to be trained.

c. Develops a working schedule and specific staff assignments for all significant milestone stages of course preparation and implementation.

d. Meets with course staff, distributes instructional guides and related training materials, and reviews the preparation plans and day-to-day working schedule; assigns specific topics and time allocation for which each instructor has instructional responsibility and for which each instructor serves as assistant to prime instructor.

e. Identifies which, if any, available options in procedures should be taught for compliance with directives of the governing regulatory authority.

f. Prepares announcemnt of the course, and distributes it as appropriate to the potential student body.

g. Reviews classroom and laboratory facilities, making arrangements for any required repairs or adaptations.

h. In consultation with instructors reviews availability and condition of all equipment, supplies, and other training resources required for the courses, and makes timely arrangements for repair and maintenance, reorder, or borrowing of needed items; arranges for supplies of student reference texts and associated training materials.

i. Works with secretary in registration of students and in all pre-course communications on schedules, local housing and transportation, and other pertinent matters.

j. If the course is to be conducted in a "field" location, coordinates timely arrangements for staff travel, transportation of equipment and supplies, arrangements for training facilities, local housing and transportation, determination of availability and location of dining facilities, and any other preparations required for course conduct away from normal base location.

k. Initiates periodic and timely checks with other training team members to assure that their pre-course preparations are on schedule and that preparation of required resources is moving ahead according to plan. Takes action as necessary to identify problems and to expedite solutions as the need arises.

l. Represents the training team in all formal communications with management, host organizations, students, and with commercial or private sources of equipment and suplies.

During the course, the Course Coordinator:

a. Is in charge of course opening exercises, including student registration, welcome and staff introductions. Presents and discusses course objectives.

b. Maintains general supervision of course, assuring that all activities are kept on schedule; maintains liaison between staff members and other interfacing organizations/individuals as necessary.

c. Maintains consolidated summary records of student performance based on information provided by other instructors; with staff determines which students should or should not be recorded as having satisfactorily met training objectives.

d. Provides Course Secretary with timely information necessary for preparation of course certificates; signs course certificates as representative of the course training staff.

After the course, the Course Coordinator:

a. Reviews and evaluates with the instructional staff all matters considered pertinent to the effective implementation of the course as planned, developing proposals and plans for adjustments as necessary for future offerings of the course.

b. Orders repair, renovation, and replacement of any equipment or supplies which need such attention. Coordinates return of any borrowed resources used in the course.

c. If course was conducted in the field, coordinates repacking and return shipment of all equipment and supplies.

d. Drafts course summary/evaluation report.

e. Prepares and forwards any reports required by other supervising, coordinating, or financing authority.

f. Prepares letters or other expressions of appreciation for services or special cooperation received from outside organizations or individuals.

2. Course Secretary

The course Secretary works under the direct supervision of the Course Coordinator, and prepares or arranges preparation of all formal communications, procurement documents, training materials, and records required for course preparation and implementation. The Course Secretary also provides office support work for the course instructional staff in all matters pertaining to course preparation and implementation.

Before the course, the Course Secretary:

a. Works with the Course Coordinator in identification and preparation of copies of all pertinent course materials for use in planning conferences between Course Coordinator and the instructional staff, including instructor's copies of working schedules for course preparation, course agenda from preliminary to final draft, staff assignments, instructor lesson guides, all student instructional materials and associated data sheets, student evaluation sheets, quizzes, and any other typed or printed material projected for course use.

b. After Course Coordinator's conference with instructional staff, and resolution of decision making issues, arranges for printing (or reproduction) and assembly of all materials indicated under (a) above; in a quantity adequate for projected course requirements.

c. Prepares projected course announcement as directed by Course Coordinator, arranges for printing or reproduction, and distribution as specified.

d. Serves as Registrar, maintaining roster and records of students submitting application and accepted for admission to the course, prepares routine response to students, announcing acceptance with information as appropriate on course dates and schedule, local "geography" including key addresses, hotel/motel/dining information, local transportation information, and any other information, which will simplify personal planning of registered students.

e. Prepares, or arranges for, all individual student supplies, including registration cards, course manuals, note paper, pencils, name tags (one for wearing and one for use at classroom seating position), course certificates, etc.

f. Prepares orders or procurement requests for equipment and supplies needed for the course based on specifications provided by the instructional staff.

g. If the course is a "field" presentation, makes arrangements for shipment of equipment and supplies to course site and return, staff travel schedules and order of tickets, hotel reservations, and associated functions.

h. Prepares classroom for use in the course, including distribution of individual student materials to seating positions, arrangements for classroom organization of audiovisual projection of playback equipment, chalkboards and associated supplies, and other classroom needs. (Ordinarily the Course Secretary does not travel to a "field" presentation; this function will have to be provided through special arrangements with the host organization at the course site.)

During the course, the Course Secretary provides classroom coordination and support:

a. Attends course opening exercises, assisting students in completion of registration cards and associated records.

b. Prepares course summary registration information, prepares class roster on first day of course and distributes copies to students and instructors, keeping copies for future records.

c. Provides clerical/secretarial support to Course Coordinator and instructional staff as required.

d. Receives incoming mail and messages for staff and students, expediting communications to extent practical and feasible.

e. Prepares course certificates as specified by Course Coordinator on last day of course.

f. Inspects classroom daily, making arrangements as necessary for coordination of deficiencies in janitorial services, and personally corrects minor deficiencies to extent feasible.

g. Attends and participates in course closing exercises.

After the course, the Course Secretary:

a. Prepares typed copy of all reports drafted by the Course Coordinator, and forwards reports as indicated.

b. Places purchase orders or procurement requests for repair, renovation, or replacement of equipment and supplies as directed by Course Director.

c. Removes all course supplies from the classroom; returns borrowed resources; leaves classroom in condition suitable for use by following class (this does not imply janitorial services!).

d. If course is conducted on repetitive basis, inventories all consumable classroom supplies, including data sheets, worksheets, quizzes, course schedules, and the like, and reorders or provides for reproduction of any items coming into short supply.

3. Instructor (Chemistry, Certification, Adminstration)

Before the course, each instructor receives course duty assignment from management, and:

a. Meets with Course Coordinator for discussions of course plans, objectives, and for development of day-to-day course preparation schedule.

b. In conference with Course Coordinator determines which if any options in tests and measurements will be taught, determines lesson guides to be followed and student reference materials to be used, and resolves any other problems on instructional materials, their content, and related matters which should be determined beforehand.

c. Reviews requirements for equipment, supplies, audiovisual training aids, and other training resources to be used in individual instructional assignments. Performs equipment upkeep and maintenance procedures, prepares supplies and reagents required to be available for student use, provides Course Coordinator with timely, detailed information on specifications for all equipment, supplies, and other training resources which must be purchased, rented, or borrowed for the course.

d. If the course is to be conducted in a "field" location, packs equipment and supplies for shipment so that they will arrive at destination in good condition; identifies to the Course Coordinator the equipment and supplies which should not or cannot be shipped which should be provided otherwise at the course site.

e. Rehearses all classroom and laboratory instructional presentations to the extent necessary to assure effective performance within the scheduled time allocation.

f. Reviews and practices all laboratory instruction for which he/she has responsibility as leading instructor to assure personal proficiency and adequacy of pre-course plans and preparations; supervises pre-course practice of other instructors who will serve as assistant instructors for specified procedures.

g. Serves as assistant instructor as assigned, developing personal proficiency through pre-course practice under supervision of the applicable leading instructor, and teaches the certification in accordance with techniques specified by the leading instructor.

h. Reports periodically as requested to the Course Coordinator on status of course preparations, and cooperates in working out timely procedures for their solution.

During the course, the instructors designated "chemist":

a. Attends and participates in course opening exercises.

b. Serves as leading instructor for the following: general laboratory procedures, basic statistics, quality control, instrument and equipment needs and laboratory safety. In addition, depending on his/her background, may be designated a lead instructor as one of the following:

   Inorganic Chemist: to serve as leading instructor for all discussions and laboratories dealing with nitrate, fluoride, and the atomic absorption determination of arsenic, selenium, cadmium, chromium, lead, mercury, barium and silver. Also to be in charge of the laboratory evaluation which covers these procedures.

   Organic Chemist: to serve as leading instructor for all discussions and laboratories dealing with the chlorinated hydrocarbons, chlorophenoxys and their determination using gas chromatography. To be in charge of the laboratory evaluation which covers these compounds.

c. Attends and participates in all classroom end-of-the-day discussions on the day's student performance.

d. Attends and participates in course closing exercises.

e. Assists other chemists as needed in their duties.

During the course, the instructor designated as Administrator:

a. Serves as leading instructor for the following instructional elements in the course: Regulations concerning the Safe Drinking Water Act and Federal/State Role in the Act.

b. Attends the end-of-the-day discussion period only on days when he has given an instructional session.

During the course, the instructor designated as "Certification Officer":

a. Attends and participates in the course opening exercises.

b. Serves as leading instructor for the lecture on "Laboratory Certification."

c. Attends and participates in all classroom end-of-the-day discussions on the student performance.

d. Attends and participates in course closing exercises.

e. Assists other instructional staff whenever possible.

After the course, all instructors:

a. Review the course implementation experience with the Course Coordinator, mutually developing proposals and plans for adjustments as necessary for future offerings of the course.

b. Evaluate condition of all equipment and supplies, initiating action to repair, renovate, or replace any items found defficient or in short supply.

c. Take necessary action to put laboratory into state of neatness and order for occupancy of the next course (this does not imply janitorial service!).

d. If course was conducted in the field, repack all equipment and supplies for return to home institution, after at least superficial cleaning of all dirty of contaminated glassware.

e. On return of shipment to home institution, unpack all equipment and supplies, returning it to designated custodial site, including return of borrowed equipment and other returnable resources.

4. Laboratory Assistant

The Laboratory Assistant is designated as "optional" in the staffing plan, but services of a laboratory assistant are strongly recommended. This is particularly urged in a fixed training installation where this and other courses are being conducted on a continuing or repetitive basis. The Laboratory Assistant works particularly in support of the instructional staff. The assistant will be given routine tasks which will free the instructional staff for more specialized or complicated tasks associated with the planning, preparation, and implementation of the training.

Before the course the Laboratory Assistant:

a. Works closely with the instructional staff members, performing standardized tasks as specified in the course preparation plan.

b. Assists Course Secretary wherever feasible in assembly and organization of student instructional materials, classroom preparation, and related tasks.

During the course, the Laboratory Assistant:

a. Performs all possible tasks in support of leading instructors.

b. Cleans and maintains all glassware and supplies.

c. Notifies leading instructor promptly of any noted discrepancies or deficiencies in supplies, equipment, or planning which leads to problems in implementing the course.

d. In field courses, packs equipment in shipping cases as rapidly as its use has been completed for the course.

After the course, the Laboratory Assistant:

a. Assists instructors in all equipment and supply inspection, renovation, and return to proper location.

b. Puts laboratory in state of neatness and order preparatory to use for next class.

c. Prepares any stable supplies required for next offering of the course, within limits of technical capability.

IV. Training Facilities

A. General Considerations

The following section describes a complete list of equipment and facilities that could be needed. A good, well equipped training center should have all the items to be able to utilize all forms of visual aids. However, not all items are required to present a training course. The Course Coordinator, in his pre-course activities, should canvass his fellow instructors to determine their facilities and equipment needs.

1. This course requires both classroom and laboratory space for class use. Effective presentation of the course requires staff attention to many details related to these facilities. Problems more often occur in field courses (i.e., away from "home base"). In any location it is unusual that all desired features of a training facility will be met, but with timely attention most problems can be solved or at least partially resolved.

2. Spatial Relationships

Classroom and laboratory should be separate, but close together. Much of the instruction requires frequent shifts between classroom and laboratory. Therefore, the classroom and laboratory, must not be in widely separated buildings, and should not be far apart in any structure.

3. Associated Comforts

a. The classroom and the laboratory should have a comfortable temperature, be free of obvious drafts, be well-ventilated, and should be well-lighted. It is, of course, possible to develop specifications for acceptable temperature ranges, light intensity ranges, humidity, etc.; but there is no substitute for exercise of good judgment.

b. Suitable restroom and drinking fountain facilities should be convenient to the classroom and laboratory.

c. Smoking

1) NO SMOKING IN THE LABORATORY. There should be no compromise on this.

2) Some schools permit smoking in the classrooms. If this is the practice, it is advisable to locate ashtrays so that smokers sit in an area where their smoking will not disturb others.

4. Lunchroom Facilities

Most schedules for this course will allow a one-hour lunch break. It is advisable that the course staff identify and make known to the class the names and locations of convenient dining facilities where service, variety, quality, and price are satisfactory.

5. Comments to Class About Facilities

a. On the first day of the course the general orientation should include such information as the class needs on the location and use of facilities and conveniences for class use.

b. It is strongly urged that members of the training staff never at any time indulge in apologies or criticisms of the classroom or laboratory facilities being used. Such remarks addressed to a class serve no useful purpose and can only detract from an effective program, provided that everything possible has been done beforehand to resolve existing problems with facilities. Student comments and complaints should be given an honest response, but such comments from students should not be regarded as an excuse for staff to enlarge on the subject.

B. Classroom

1. General Features

a. Door at rear of room is preferred; this permits entry of latecomers without excessive distraction of class.

b. The classroom should be free from excessive extraneous noises, such as from construction projects, heavy traffic, or from aircraft.

c. The classroom should have adequate electric power outlets (115V) for use of audiovisual equipment. The receptacles should be inspected for assurance that they are compatible with the plugs used on the audiovisual projector equipment being used, and adapters and extension cords secured as required.

d. Room size should be adequate for seating 18 students or the number of students for which the course was designed, plus providing for instructor equipment, projection equipment, and a modest number (4 to 8) of intermittent visitors to the classroom.

e. The classroom should be capable of being darkened quickly and effectively for use of projection equipment or television. Room dimmer lights for indirect lighting (not striking the screen directly) are recommended in fixed training installations, but can be dispensed with in a field training situation.

2. Student Facilities

   a. Ideally, students should be seated at tables, with all seats facing the instructor's area at the front of the classroom. Each student should be allocated 30" or more of table width. The sidearm chairs so familiar in the classrooms of secondary schools and colleges may be used if absolutely necessary, but are distinctly inferior to tables for student work.

   b. Student seating should be at least two screen widths from the projection screen (assuming a 6' screen, no student would be closer than 12' from the screen) and not more than 6 screen widths from the screen (again assuming a 6' screen, no student more than 36' from the screen). Furthermore, all students should be seated within a 30° angle to the left and to the right of a line from the middle of the projection screen to the projector.

3. Classroom Instructional Facilities

   a. Lectern, either freestanding or table-type, suitable for standing instructor.

   b. Demonstration table at front of classroom, approximately 3' x 5'.

   c. Chalkboard, at least 3' x 5' (preferably larger), with chalk, erasers, pointer.

   d. Audiovisual Equipment

      1) Public address system (optional but recommended) with lavalier microphone with adequate cord length to permit instructor to move about at front of classroom with relative freedom.

      2) Projection screen (for size consideration see 2.b. above), matte, beaded, or lenticular surface.

      3) Projector, 35-mm slide projector for slides mounted in cardboard or plastic mount; carousel type preferred. Several trays or slide containers should be available. Should have projection lens with cord length suitable for use from rear of room.

      4) Projector, overhead type, for use with projectuals approximately 7" x 9".

      5) Cassette type playback unit, with cueing feature for automatic operation of cassette type slide projector; compatible with National Training and Operational Technology Center (EPA) tape/slide instructional units.

6) Television tape playback unit (3/4" cassette type, "U-Matic" or equivalent).

7) Television receiver, commercial type, color, 19" diagonal picture, or larger. At least one receiver preferably two.

8) Projector, 16-mm sound movie projector with take-up reel and spare projection lamp.

e. Table, approximately 3' x 5' at rear of the classroom to place the projectors on.

f. Flipchart easels (2) and large pads of paper.

V. Laboratory Facilities

A. General Considerations

1. Should be well-lighted, adequately ventilated. It is particularly important that the laboratory be free from strong drafts in student working areas.

2. Should provide for students to stand at laboratory benches, approximately 36" from floor to bench surface.

3. Conventional laboratory services should be available at student work areas, including electricity (115V), gas, and vacuum.

4. Space between benches should be adequate for students to work without interfering with each other, and to permit free movement of instructors in the student working area.

5. Safety features of the laboratory should be checked, including location and condition of first aid kits, fire extinguishers, emergency showers, eye-wash facilities, and other emergency equipment.

6. Adequate hood facilities should be available with normal laboratory services in or near the hood.

B. Student Facilities

1. Provide at least 6' of bench width per student pair. While students will work in pairs to the extent that they will share certain limited equipment, each student will perform all tests and measurements.

2. Provide bench space or floor space as necessary for laboratory equipment described in the equipment and supply lists, such as autoclave, balances, incubators, ovens, waterbaths and other items not assigned to individual student work.

C. Instructional Facilities

1. A chalkboard and demonstration table are recommended.

2. Provide at least 20 square feet for reserve supplies and equipment of each instructor (chemist, microbiologist, engineer).

3. For field courses, provide an area for packing and unpacking equipment to be shipped. This should be at least 100 square feet of floor space with at least 20 square feet of table space.

VI. Security

Valuable property is used both in the classroom and in the laboratory. Some of the items are particularly susceptible to theft. Accordingly:

A. Provide for locking of both classroom and laboratory when not in use, or assure that adequate security is provided in the facility by other means.

B. Be sure that the necessary keys are available to the instructional staff as they are needed.

C. With field courses, often it is necessary for the training staff to work in evening or weekends to prepare for coming classwork. Arrangements must be made well in advance to secure authorized entry to the training facilities being made available by a host organization.

D. Thefts during normal working hours may be a special problem. Maintain surveillance to the extent practical, and keep out-of-service theft-prone items out of exposed locations.

VII. Secretarial Support

The key role of the office worker(s) designated "Course Secretary" cannot te overemphasized.

Depending on the size of the training facility staff, this person or persons has many duties--including, among others, assisting the Course Coordinator, being the Course Registrar, being the Course Secretary, and being a guard, to give alarm when essential milestone stages of course planning and preparation are being overlooked.

Three elements of the secretarial duties are considered here:

A. Course Records and Record Keeping

1. General Considerations:

a. Complete, detailed, and accurate records should be established for each course presentation. Each course record will be a separate file. In addition to the individual course files, it may be necessary to establish a finder-system for locating the records of individual students.

b. Response to inquiries about former students:

1) Students enroll in this course in order to acquire necessary knowledge and skills to perform the monitoring procedures required for drinking water treatment plants.

2) In many, if not all, cases satisfactory completion of this course will be a factor in the accreditation of individuals to perform laboratory analyses.

3) It is anticipated that numerous inquiries from former students and from regulatory agencies will be addressed to the training institution. Typical requests for information may include any or all of the following:

    a) Verification of attendance and satisfactory completion of training.

    b) Quality of student performance in the course.

    c) Documentation of any other events which made the student unusual. This could be a record of exceptionally high performance, or it could be a record of any specific difficulty which arose in connection with student, within or outside the scheduled training activities.

c. Reports

It is vital that complete records be faithfully kept by the training facility. Numerous inquiries can be expected from State, Federal or local authorities requesting information on course completion of the students. In the event that the training authority and certification authority are the same, the records might have to include information on any additional requisites for certification required by the authority.

Most training institutions require submission of periodic reports on progress and achievements. It is safe to predict that management of cognizant regulatory agencies from time to time will call for information not provided in routine reports. If such demands are to be met, complete course records will be the most reliable source for such information.

The length of time course record files should be retained is uncertain, and must be determined by each training facility. However, if recertification of the Certification Officer is required periodically, the time interval should dictate the time of record retention.

Facilities having a system of archives for inactive files may find it convenient to retain course records in active office files for approximately two years, then retire them to archives storage. Facilities not having archives storage probably should retain the complete file on each course presentation for at least five years.

d. Contents of Course Files

1) In the planning and development stage, and until completion of each course presentation, course records are kept most effectively in two sections. These are:

   a) A file folder, kept in the filing cabinet or in the desk of Course Secretary.

   b) A student record notebook, usually a 3-ring binder, kept on the Course Secretary's desk, or in a convenient bookcase.

   Both elements of these files should be maintained by the Course Secretary, and should be made available to other staff members under rigid controls providing for direct examination and immediate return. After completion of the course, the two elements of the course file can be combined in a single large file packet for future retention.

2) The file folder is best suited for such records as:

   a) Copies of all correspondence, memoranda, and records of telephone conferences related to course planning and development.

   b) Copies of course schedules.

   c) Records of equipment and supply acquisition for the course, through purchase or through loan (with information and records on return to owner).

   d) Records of staff assignments, classroom and laboratory reservations.

   e) Sample record copies of all routine informational material sent to students accepted for training.

   f) Copy of course announcement.

   g) Records of arrangements for travel of personnel and transportation of equipment and supplies, arrangements for field facilities, and other records pertaining to a field course.

   h) Course evaluation commentaries by Course Coordinator and other staff members as appropriate.

3) The student record notebook is best suited as a vehicle for all records and copies of communications related to individual students. This may be organized effectively in a 3-ring notebook, containing separator sheets with alphabetical tabs. The personal records of each student will be retained under the alphabetical tab corresponding with his last name. In the student record notebook may be found:

a) At the front (before the "A" of the series of tabbed dividers):

   (1) A summary sheet showing record of standard communications with each accepted student fees paid, etc.

   (2) A summary sheet showing record of students who applied for admission but could not be admitted for lack of qualification, or due to an already-filled class. This summary also is used to identify applicants who applied for admission, who were admitted, and who failed to appear without due explanation ("no shows").

   (3) A summary sheet recording student performance (acceptable or not acceptable) for each of the units of instruction in the course.

b) In the alphabetical section of the student record notebook, each student's personal record will contain such items as:

   (1) The application for admission to training.

   (2) Copies of all coorpesondence with the student, except for the routine local inforamtion sheets, one set of which is kept in the loose file folder.

   (3) Record copies of student quizzes, data sheets, and other individual records of class performance provided by the instructor.

   (4) Documentation of any information about the student judged to be of possible future concern or inquiry.

2. Suggested Student Registration Procedures

   a. Purpose

   Formal registration and enrollment procedures are intended to assure that:

   1) The class consists of students for whom the training is intended and designed.

   2) The accepted students meet minimum knowledge and skills required for reasonable assurance of satisfactory completion of the course.

   3) Accepted students are provided with adequate pre-training information so that they will make their personal arrangements and travel schedules to assure arrival at the appointed time and place, with full participation throughout the program of training.

   4) The size of the class is in accordance with the course plan.

5) Those not accepted for training are provided with suitable advice which can lead to future admission.

b. Alternative Approaches to Registration

Three different approaches to registration are considered here, though only the first is described in detail. Most details of the second and third identified alternatives can be inferred through study of the first alternative. The three approaches considered are:

1) Registration by priority of receipt of application.

2) Registration by comparative evaluation of all applicants.

3) Registration for special course offering at request of another organization. Students are nominated by the requesting organization and are accepted without further evaluation of entry-level qualifications by the training institution.

c. Alternative Registration Procedures

1) Registration by priority of receipt of application (recommended)

a) Applicant receives course announcement

(1) Completes application and secures internal approvals as required in his own organization.

(2) Mails application to registration office of the institution conducting the training.

b) Course Secretary receives application, and as received:

(1) Records application in registration summary in front of student notebook.

(2) Checks status of registration for availability of class space, and makes appropriate notation on the application or on attached transmittal slip.

(3) Delivers application to Course Coordinator.

c) Course Coordinator

(1) Evaluates the student application and the space availability situation.

(2) By notation on the application or on a transmittal slip, directs the Course Secretary to:

(a) Accept the applicant, or

(b) Notify the applicant of closed class enrollment, or

(c) Refer the applicant to other sources of training (Federal, State, regional, colleges).

(3) For non-admissible applicants, prepares a special letter (or memorandum record of other form of communication with applicant) which sets forth the reasons why the applicant is being rejected.

d) The Course Secretary

(1) Prepares a standard letter or special letter as directed, and obtains signature of Course Coordinator.

(2) Places a file copy of the letter and the application in the appropriate place under the alphabetical tab section of the student record notebook.

(3) Mails the original letter to the applicant, and records the date of mailing in the appropriate place in the summary records at the front of the student notebook.

(4) Approximately 20 to 30 days before the course, mails to each accepted applicant a standard communication, consisting of:

(a) The participants manual along with all course handouts available before the course as well as a list of the pre-course reading materials submitted by the instructors.

(b) A form letter, such as the who, when, where, of welcome to the course, including information on starting and closing dates and hours of the course, directions and how to proceed to the classroom area, and other related information.

(c) Local information helpful to outside visitors, such as hotel/motel information, local transportation schedules ad a schematic map of the area.

(d) A biographical statement, if this information was not contained in the application form and the participants' survey form, if the Course Coordinator has chosen to use it.

(5) Secretary records the mailing of the standard packet on the registration summary sheet.

(6) When applications are still being accepted within 30 days before the start of the course, the general informational material is included with the letter of acceptance for admission.

(7) On the first day of the course:

(a) Obtains a detailed registration card from each student. (Some institutions may dispense with this record, though it can be of value in report preparation.)

(b) Prepares a class roster of those in attendance, and distributes to class, staff, and keeps a permanent record copy in course files.

(c) Records any "no shows" (applicants accepted for training but who did not appear) in the student summary record sheet.

d. Registration by Comparative Evaluation of all Applicants

1) The applicant receives course announcement.

a) Completes application and secures internal approvals as required in his own organization.

b) Mails application to registration office of the institution conducting the training.

2) The Course Secretary receives the applications.

a) Records receipt of application in summary record in student record notebook.

b) Files application in student notebook.

c) Sends standardized letter acknowledging the application, and briefly explaining the registration procedure, with assurance that decision on admission will be announced not less than 30 days prior to start of the course.

d) Approximately 35 days before start of the course, delivers all applications to the Course Coordinator.

3) The Course Coordinator reviews and evaluates all applications, selects students to be admitted for training, and directs Course Secretary to send appropriate standardized letters and information packets as described in D.2.c.1) above. Special note should be taken of the particular attention which should be given to rejected applicants.

4) The Course Secretary sends communications and prepares records and student files as described in D, above.

e. Registration with Special Course Offering

Here a requesting organization has designated the student body which it wishes to have trained. It is the duty of the training institution to provide the requesting organization with admission standards for the course. It becomes the duty of the requesting organization to screen its candidates for conformance to these standards, and to provide the training institution with the names of the students to be trained. The requesting organization usually notifies the students.

1) For record purposes, it is best that students complete a course application form, though it will not be evaluated as in D.2.c.1), D.2.d.1), above.

2) On receipt in the training institution, the Course Secretary makes the necessary entries, showing record of receipt and class composition, files are kept in the usual way. Approximately 30 days before the course, the individual standardized welcome and information packets are sent to students in the usual way. The training organization follows its usual practices in preparation of records, rosters, and any other data required for records and reports.

3. Printed and Reproduced Materials

a. General Information

1) One source of students will be the referral by the laboratory Certification Officer. When he visits a laboratory that he feels may have need of information contained in the course, he can refer them to the appropriate person for action on their application. If the course is given on a regular schedule, laboratories may wish to use the course as a training vehicle for new employees or those individuals whose responsibilities have changed.

Samples of course announcements and applications are included under Tab C2. The timing in the milestones section (C1) and the following section serve as an example. However, as denoted by the timing of 5 to 6 months, ample time must be allotted before the starting date of the course to allow response of the students. The Course Coordinator should make appropriate changes in the timing sequence to fit his circumstances.

2) In addition to the student reference text, presentation of this course requires a number of forms, quizzes, worksheets, standardized letters, and administrative materials which are prepared in some numbers or which lend themselves to standardized format and style.

3) In the following summary pages, these materials are identified and supported with additional information on due date, the number to be prepared (for a class of 16 students), and the ultimate fate of the materials in permanent course records. Instututions offering this course may find it necessary to add to or to modify these standardized materials. It is suggested that appropriate notation be made in the summary sheets, with samples or examples provided in the following pages.

4) A sample or example of each item listed (except the student reference text) is shown following the summary sheets.

   a) Samples can be copied directly, if meeting requirements of the training institution.

   b) The examples are shown in recognition that a corresponding item probably will be needed by the training institution, but probably will have to be modified to fit the sitution.

b. Responsibilities for Printed and Reproduced Material

1) Course Coordinator

   a) Reviews the administrative materials for conformance to the requirements of the regulatory authority.

   b) Makes modifications as necessary to the samples and examples provided in this Guide.

   c) Decides upon any additional administrative documents or records needed, and designs a sample document.

   d) Provides the Staff Secretary with complete identification of material to be copied directly, to be modified, and with sample of new material required for course administration.

2) The Instructors

   a) Review all materials identified for the procedures for which they have instructional responsibility..

   b) Make adjustments in the sample documents as required.

   c) Design new supportive instructional materials as required.

   d) Provide the Staff Secretary with complete information on material to be copied directly, to be modified, and with sample of new material required for student instruction.

3) The Staff Secretary

   a) Receives from Course Coordinator and Instructors identification of existing materials, samples of modified, and with sample of new material required for student instruction.

   b) Adds to the summary sheets, in the appropriate locations, the identifying information, together with the supporting information on due date, quantity, confidentiality, and ultimate fate of any new or revised material designed by Course Coordinator or by Instructors.

c) Reproduces, or arranges reproduction of, the needed course materials so that they will be available for use at the time and place required.

c. Special Warnings

1) All staff members should be particularly alert to adjustments in "Due Date" which must be made when the course is conducted in the field, in which training equipment and supplies must be shipped to the course site.

2) Preparation of these training materials is a potential source for great difficulty in course development and presentation. Few activities in course planning and development require a greater amount of effective teamwork among all staff members. The greatest problem here is one of timing.

a) All staff members must provide necessary information and samples of new or modified materials with adequate lead time to meet "Due Dates." The amount of lead time is not specified here; this will vary from one institution to another.

b) The Staff Secretary must be diligent in advising Course Coordinator and Instructors of impending logistic problems if delays occur in submission of materials, and must give prompt attention to printing or reproduction of needed materials when delivered by staff members.

c) The author of this guide ruefully confesses that the worst and most frequent breakdowns in this area usually are the result of belated delivery of needed material from Instructional Staff to the Staff Secretary.

SUMMARY OF REQUIRED PRINTED/REPRODUCED MATERIALS

Description	Tab Location of Example	When Needed	Number to be Prepared	Confidential	Permanent Record	Remarks
Administrative Course Announcement	C-2	5 to 6 months before course	Indeterminate	No	1 copy	If the attendees are designated this time can be adjusted accordingly by the Course Coordinator.
Application for Admission	C-2	5 to 6 months before course		No	No	May be omitted if State appoints persons, provided biographical sketch is provided by State.
Standard Letter: Acceptance (or)	C-2	90 days before course	20	No	No	Copies will show up in student files--should be sent with participant manual.
"Who, When, Where" Letter	C-2	30 days before course	20	No	1 copy	This can be used in place of the letter format for acceptance. It should be included with the participants manual. Note difference in timing.
Biographic Sketch	C-2	90 days before course	20	No	Yes	The example application for admission has sufficient information so that this form is not needed. However, one or the other should be used.

Description	Tab Location of Example	When Needed	Number to be Prepared	Confidential	Permanent Record	Remarks
Standard Letter: Full Class - Waiting List	C-2	90 days before course	10	No	No	Copies will show up in student files.
Standard Letter: Local Information: Lodging, Transportation, Maps, etc.	C-2	30 days before course	20	No	1 copy	Can be included as part of student manual when manual is sent to student before course begins.
Trainee Registration Card	C-2	First day of course	20	No	Yes	
Daily Participant Feed Back	G	First day of course	100	No	Yes	Include in manual-elective for student.
Pre-Test	G	30 days before course or first day of course	20	Yes	Yes	The Course Coordinator may elect to send this to student or give the test on the first day of the course.
Roster	C-3	Second day of course	20	No	Yes	
Registration Summary Card	C-2	Last day of course	1	No	Yes	In Registrar's three-ring notebook.
Post-Test	G	Last day of course	20	Yes	Yes	
Course Evaluation	G	Last day of course	20	No	Yes	In Registrar's notebook.
Certificate of Attendance	C-2	Last day of course	20	No	No	
Course Follow-up Evaluation	G	Last day of course	20	No	No	

EXAMPLE COURSE ANNOUNCEMENT

METHODS FOR THE DETERMINATION OF CHEMICAL CONTAMINANTS IN DRINKING WATER

The State of __________ (or Region of) is offering a training course for laboratories concerned with analysis of chemicals in finished potable waters. The course is designed to cover the methodology as covered in the State (or Federal) Drinking Water Regulations.

The course will cover the inorganic and/or organic parameters which must be monitored for under the Safe Drinking Water Act. There will be classroom as well as laboratory instruction. All persons attending should be familiar with basic chemical techniques such as making dilutions, standards, be able to pipet and use basic equipment such as balances, water baths, etc.

The course will be offered in (name of city) at (building and address). The week of (date of course) will be the date of offering. There will (or will not be a fee) of $_______.

Persons wishing to apply for the course should contact (name of Course Director) at the following address:

E X A M P L E

ANNOUNCING
USEPA SPONSORED INSTRUCTOR TRAINING FOR PERMIT COMPLIANCE

The National Training and Operational Technology Center has developed a series of "packaged" courses for training municipal treatment plant personnel how to sample, measure, and analyze their wastewater discharges so as to comply with NPDES Permit requirements. Instructional materials for each course have been prepared in modular form, with each module containing detailed step-by-step procedures for the performance of a specific monitoring task. A description of each course so far developed appears below.

The National Training and Operational Technology Center provides tuition-free courses for instructors engaged in this type of training in Federal, State, and Local water pollution control programs, and in educational institutions. In these courses the student-instructors perform each self-monitoring task. In addition, they become thoroughly familiar with the organization and recommended use of the instructional materials; with training aids and other technical assistance available from USEPA for this type of training; with the planning and implementation of intensive training programs; with recommended instructional techniques; and with USEPA regulatory requirements for NPDES self-monitoring. These latter subjects are dealt with in depth only in course 164.1 which is an 8 day offering for student-instructors. It is recommended that interested instructors attend this course prior to any of the others.

164.1
Effluent Monitoring Procedures: Basic Parameters for Municipal Wastewaters
5 days
(8 days for student-instructors)

This course is intended for municipal wastewater treatment plant technicians and others engaging in analysis of wastewater treatment plant effluents for compliance with requirements of discharge permits issued under the National Pollutant Discharge Elimination System. Upon completion of training, the student will be able to collect samples, perform the tests, and report results for BOD, fecal coliforms, pH, suspended solids, residual chlorine, and measure flow by weirs and parshall flumes. Laboratory test procedures conform to Agency-approved methods as promulgated in the Code of Federal Regulations.

164.2
Effluent Monitoring Procedures: Metals Analysis
5 days

This course is designed for wastewater treatment plant technicians who will be responsible for performing selected metals analyses in treatment plant effluents. Participants will perform selected metals analyses including: boron, copper, iron, mercury, sodium, and zinc. Classroom instruction is limited to information about performing these analyses and reporting the results. Most of the time is given to laboratory experiences for the trainee who uses detailed, stepwise procedures to analyze typical samples. Procedures will be in conformance with Agency-approved methods as promulgated in the Code of Federal Regulations.

164.3
Effluent Monitoring Procedures: Nutrients
5 days

This course is designed for municipal wastewater treatment plant technicians who are responsible for self-monitoring of nutrient concentrations in treated effluents to comply with requirements of discharge permits issued under the National Pollution Discharge Elimination System. Upon completion of the course, participants will be able to perform selected analysis for Chemical Oxygen Demand; the Nitrogen Series (Total, Ammonia, Nitrate, Nitrite); Total Phosphorus. The test procedures conform to Agency-approved methods as promulgated in the Code of Federal Regulations.

164.5
Effluent Monitoring Procedures: Flow Measurement & Sampling Techniques
5 days

This course is designed for the treatment plant operator or technician who is required to monitor effluent discharges under a National Pollutant Discharge Elimination System (NPDES) Permit, and who has had little or no previous experience in collection of wastewater samples, or in measuring wastewater flows. Following classroom discussions and demonstrations, participants measure flows and collect samples at a wastewater treatment plant using both manual methods and automatic devices; and also measure effluent parameters on-site; using portable field instrumentation.

☆ U.S. GOVERNMENT PRINTING OFFICE 1976 — 757-005/0005

APPLICATION FOR INSTRUCTOR TRAINING

I am interested in attending the following training course or courses in Cincinnati, Ohio:

1. Effluent Monitoring Procedures: Basic Parameters for Municipal Wastewaters (164.1) ☐
   July 11–20, 1977
2. Effluent Monitoring Procedures: Metals Analyses (164.2) ☐
   June 13–17, 1977
3. Effluent Monitoring Procedures: Nutrients (164.3) ☐
   August 1–5, 1977
4. Effluent Monitoring Procedures: Flow Measurement and Sampling Techniques (164.5) ☐
   June 27 – July 1, 1977

(For additional offerings of these courses, call the NTOTC Registrar – 513/684–7501)

Organization in which you will be providing instruction: ____________________

Your Name ____________________ Phone ____________

Business Address ____________________

____

____

____

EXAMPLE APPLICATION FORM

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Form Approved
OMB No. 158-R0005

1. NAME OF APPLICANT *(First, middle, last)*
MR.
MRS.
MISS.

2. TITLE OF COURSE DESIRED

3. COURSE NUMBER

4. PLACE WHERE GIVEN

5. DATES

6. SPONSOR OR EMPLOYER *(Name, address)*

City State Zipcode
Phone no.

7. MAILING ADDRESS OF APPLICANT *(If different from item 6)*

City State Zipcode
Phone no.

8. PROFESSION OR OCCUPATION

9. TOTAL YEARS EXPERIENCE IN PROFESSION

10. POSITION TITLE

11. BRIEF DESCRIPTION OF YOUR PRESENT POSITION

12. PREVIOUS WATER POLLUTION CONTROL TRAINING COURSES ATTENDED

TITLES	DATES	LOCATION

13. HIGH SCHOOL GRADUATE ☐ YES ☐ NO

14. NUMBER OF YEARS EDUCATION COMPLETED BEYOND HIGH SCHOOL

15. COLLEGE OR UNIVERSITY EDUCATION

NAME OF INSTITUTION	DATE ATTENDED	MAJOR	DEGREE

16. SIGNATURE OF APPLICANT

17. DATE

18. SIGNATURE OF APPROVING OFFICER *(Where applicable)*

19. TITLE

20. DATE

21. AGENCY USE ONLY

AMT. REC'D. ________ DATE ________ BILLING INFO. ________

(SAMPLE LETTER OF ACCEPTANCE FOR TRAINING)

(Institutional Letterhead)

(Date)

(Addressee)

Dear (Name):

A reservation has been confirmed for your participation in the course "Methods for the Determination of Chemical Contaminants in Drinking Water" to be conducted at (address, including building and room identification if pertinent).

Formal class activities will begin promptly at (time) on Monday, (date) and the course will be completed by (time) on Friday, (date). Please arrange your travel schedule so that you will be in the classroom at the start of course activities on Monday and that you will not have to hurry your departure on Friday.

Information about local travel, transportation, and local hotels is enclosed for your assistance. We believe that you will wish to make your own hotel or motel reservations.

We look forward to seeing you at the course, and we will do everything in our power to make this course a pleasant and rewarding experience for you.

Sincerely yours,

(Signature)
Course Coordinator

Note: If something develops which makes it impossible for you to attend the course, please telephone or write this office immediately, in order that another applicant may be admitted to the course in your place. Please do not arrange for a substitute without first getting the approval of this office.

WHO, WHEN, WHERE

This form should be completed and sent along with the Manual or inserted in each of the participant's manuals as a cover to the first Tab. This will insure that each participant has a timely reminder of dated and addresses.)

Date:

Welcome:

This course is being presented to you by ____________________

The ____________________ in ____________________

It will be given on consecutive _______ the (weeks) (days) of

____________________ at ____________________ in ____________________.

The address is ____.

If you have any questions, please call ____________________

at (#) ______________.

We look forward to meeting you.

Sincerely yours,

(Signature)

BIOGRAPHIC STATEMENT

Dear Participant:

We ask that you answer and complete the following items as briefly as possible. The purpose is simple: to acquaint the instructor with his/her students prior to the course.

1) Name: (please print)

2) Date:

3) Address:

4) Date of Birth:

5) Present position or job title:

6) Major job functions or responsibilities:

7) Courses or study undertaken in relation to job:

(SAMPLE STANDBY LETTER)

(Institutional Letterhead)

(Date)

(Addressee)

Dear (Name):

We have received your application for admission to the course "Methods for the Determination of Chemical Contaminants in Drinking Water" to be conducted at (name of institution) during the period (date to date).

We would be most pleased to enroll you in this course, but by the time we received your application, all available positions in the class had been reserved. As you may know, we limit the class size to a fixed number in order to provide for the greatest possible amount of personal instruction during the course, and to provide each participant with the greatest possible opportunity for actual practice in the laboratory.

We have made a tentative reservation for you in the next offering of the course, which is scheduled to be given (dated). If this will be satisfactory to you, please write or call us within (number) days, so that we can confirm your reservation.

In the meantime, we have placed your name on the waiting list for the course dates which you requested. If a vacancy does become available, we will let you know immediately.

Sincerely yours,

(Signature)
Course Coordinator

(EXAMPLE)

(Date)

TO: COURSE PARTICIPANTS

We are looking forward to your participation in the course "Methods for the Determination of Chemical Contaminants in Drinking Water" scheduled for presentation at this Center during the period (date to date). If you find you cannot attend the course, please call us (telephone number).

To assist your planning preparation for this course, the following items are enclosed:

1. List of hotels and motels
2. Information on local bus transportation and city map. (NOTE: If bus service is used to the Center, you must have exact fare of $.25 on boarding bus).

On your arrival in the classroom you will be provided a course manual and related materials. Production schedules make it impossible to mail manuals to you in advance of the course date.

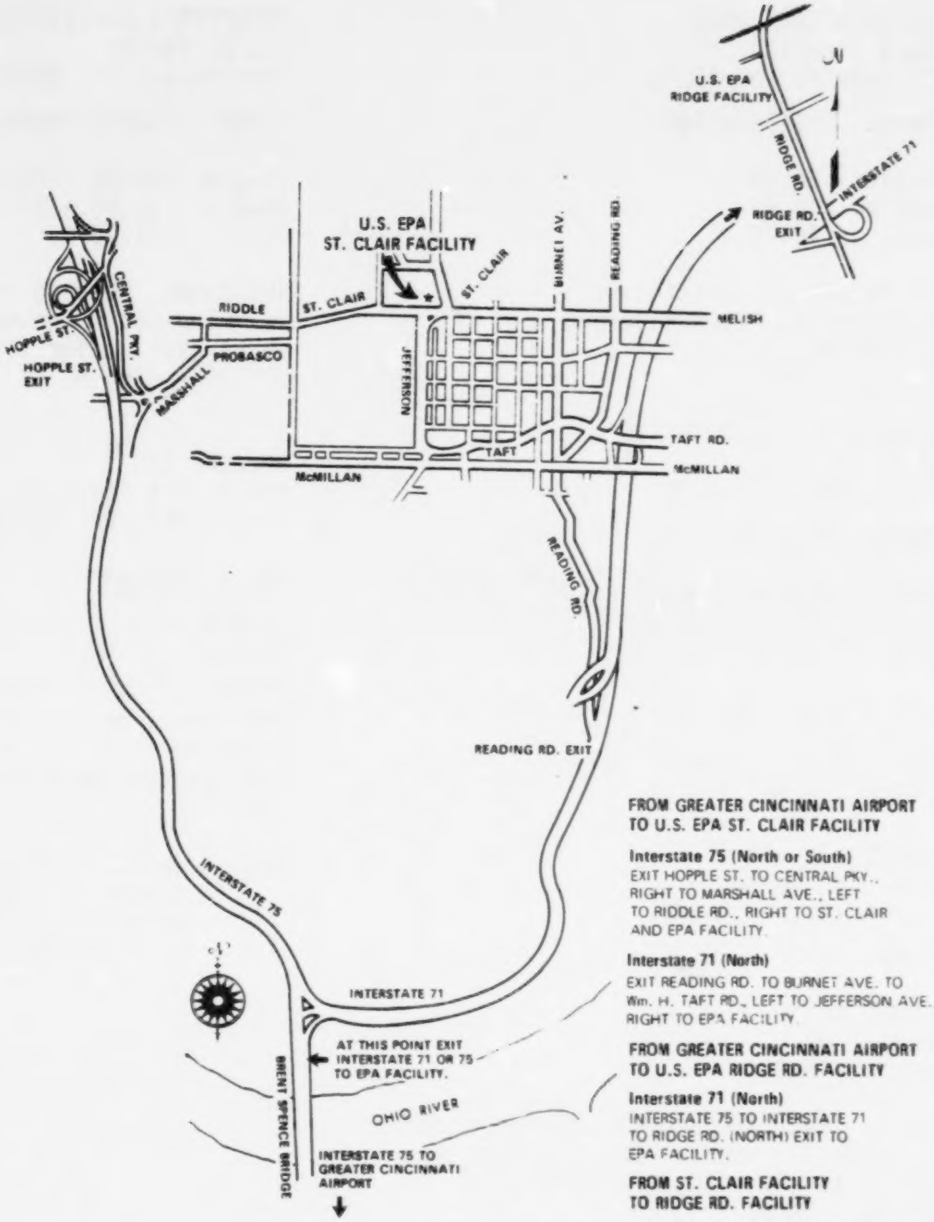
The course will start at 8:30 a.m. on Monday, (date) in Classroom (#) and will close no later than 4:30 p.m. on Friday, (date). At the conclusion of the course, a certificate will be awarded the participants who have attended all sessions and met the training objectives. Please arrange your travel schedule after closing exercises. (Approximately 1 hour should be allowed for travel from the Center to the airport.)

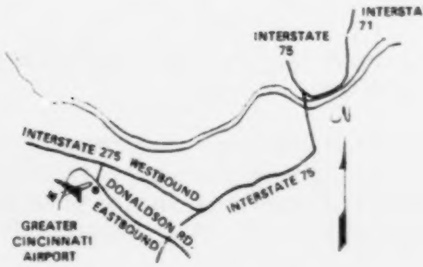
Mr. (Course Coordinator), of our staff, is serving as Course Coordinator and will be available to assist you in solving any special problems you encounter while attending the course.

Should you have questions or desire assistance in any way, please do not hesitate to contact us.

Sincerely yours,

(Signature)
Director, National Training and
Operational Technology Center


U.S. EPA
RIDGE FACILITY
RIDGE RD.
INTERSTATE 71
RIDGE RD. EXIT
U.S. EPA
ST. CLAIR FACILITY
ST. CLAIR
BURNET AV.
READING RD.
MELISH
RIDDLE
ST. CLAIR
HOPPLE ST.
HOPPLE ST. EXIT
CENTRAL PKY.
PROBASCO
MARSHALL
JEFFERSON
TAFT RD.
TAFT
McMILLAN
McMILLAN
READING RD.
READING RD. EXIT
INTERSTATE 75
INTERSTATE 71
AT THIS POINT EXIT INTERSTATE 71 OR 75 TO EPA FACILITY.
BRENT SPENCE BRIDGE
OHIO RIVER
INTERSTATE 75 TO GREATER CINCINNATI AIRPORT


INTERSTATE 75
INTERSTATE 71
INTERSTATE 275 WESTBOUND
EASTBOUND
DONALDSON RD.
INTERSTATE 75
GREATER CINCINNATI AIRPORT

FROM GREATER CINCINNATI AIRPORT TO U.S. EPA ST. CLAIR FACILITY

Interstate 75 (North or South)

EXIT HOPPLE ST. TO CENTRAL PKY., RIGHT TO MARSHALL AVE., LEFT TO RIDDLE RD., RIGHT TO ST. CLAIR AND EPA FACILITY.

Interstate 71 (North)

EXIT READING RD. TO BURNET AVE. TO Wm. H. TAFT RD., LEFT TO JEFFERSON AVE. RIGHT TO EPA FACILITY.

FROM GREATER CINCINNATI AIRPORT TO U.S. EPA RIDGE RD. FACILITY

Interstate 71 (North)

INTERSTATE 75 TO INTERSTATE 71 TO RIDGE RD. (NORTH) EXIT TO EPA FACILITY.

FROM ST. CLAIR FACILITY TO RIDGE RD. FACILITY

JEFFERSON TO McMILLAN, LEFT TO INTERSTATE 71 NORTH, EXIT RIDGE RD. NORTH TO FACILITY.

FROM U.S. EPA ST. CLAIR FACILITY TO GREATER CINCINNATI AIRPORT

RIGHT ON ST. CLAIR TO RIDDLE RD., LEFT ON MARSHALL AVE., RIGHT ON CENTRAL PKY., LEFT ON HOPPLE ST., RIGHT TO INTERSTATE 75 SOUTH.

FROM U.S. EPA RIDGE RD. FACILITY TO GREATER CINCINNATI AIRPORT

RIGHT ON RIDGE RD., RIGHT TO INTERSTATE 71 SOUTH TO INTERSTATE 75 SOUTH.

DOWNTOWN HOTELS

CINCINNATIAN HOTEL
6th & Vine Sts.
Cincinnati, OH 45202

Phone: 513/241-0180

Single	$6.45
Double	8.60
Twin	10.75

225 Rooms. One meeting room, capacity 25, TV, restaurant adjoining.

NETHERLAND HILTON HOTEL
35 W. 5th St.
Cincinnati, OH 45202

Phone: 513/621-3800

Single	$22.00 - 36.00
Double	30.00 - 44.00
Twin	39.00 - 46.00

($29.00 -most available)

Family plan, 800 rooms, TV, meeting rooms 15, special Gov't. rates - $18.00 single, $28.00 double, $28.00 - twin.

TERRACE HILTON HOTEL
15 W. 6th Street
Cincinnati, OH 45202

Phone: 513/381-4000

Single	$24.00 - 46.00
Double	31.00 - 54.00
Twin	35.00 - 54.00

Family plan, 350 rooms, meeting rooms 4, color TV, special Gov't. rates - $20.00 single, $30.00 double, $30.00 - twin.

STOUFFER's CINCINNATI TOWERS
150 W. 5th St.
Cincinnati, OH 45202

Phone: 513/721-8600

Single	$25.00 - 28.00
Double	31.00 - 34.00
Twin	31.00

462 rooms, meeting rooms 11, swimming pool, cocktail lounge, sauna bath, color TV, Gov't. rates, $22.00 - single, $27.00 - double.

HOLIDAY INN *
8th & Linn Sts.
Cincinnati, OH 45203

Gov't. Rates**

Single	$19.00 (includes tax)
Double	21.00 (" ")

Phone: 513/241-8660

245 rooms, meeting rooms 4, swimming pool, TV, 2 dining rooms, bars, and night club "Top of the Inn".

** Note: Gov't. Rate will be extended to any person attending an EPA meeting or training course.

NOTE: We recommend you checking the rate at the time you make your reservation in the event there has been a price increase.

These hotels and motels are listed for your information to assist you in planning for your accommodations during your stay in Cincinnati while attending our training course, and does not imply endorsement by the Office of Water Program Operations, U.S. Environmental Protection Agency.

* REQUIRES TRANSFER TO SECOND BUS.

SUBURBAN MOTELS

TREADWAY MOHAWK INN*
2880 Central Parkway
Cincinnati, Ohio 45225

Phone: 513/681-3330

Single $17.00 (1 dble. bed - 1 person)
Double $24.00 (2 dble. beds - 2 persons)

Gov't. rate extended to any person attending EPA Training Courses or EPA sponsored meetings. Reservation should be made in advance. Rooms will be held until 6:00 PM only unless guaranteed.

Color TV, swimming pool (outdoor), restaurant, cocktail lounge, room phone service.

Manager: Mr. George Meise

CINCINNATI TRAVELODGE*
3244 Central Parkway
Cincinnati, Ohio 45225

Phone: 513/542-3200

Single $13.50 (1 dble. bed - 1 person)
Double $19.00 (2 dble. beds - 2 persons)

Gov't. rate extended to any person attending EPA Training Courses or EPA sponsored meetings.

Color TV, swimming pool (outdoor), room phone service, restaurant next door (Frisch's)

Manager: Mr. Bill Waite

GATEWAY LODGE MOTEL OF CINCINNATI*
4453 Reading Road
Cincinnati, Ohio 45229

Phone: 513/242-2593

Single $12.00 (1 dble. bed - 1 person)
Double $14.00 (2 dble. beds - 2 persons)
" $14.00 (1 dble. bed & 1 twin bed - 3 persons)

Swimming pool (outdoor), TV, room phone service, restaurant nearby. Close to I-71 & I-75.

Owner: Mr. Richard Moore

TOWN CENTER BEST WESTERN MOTEL*
3356 Central Parkway
Cincinnati, Ohio 45225

Phone: 513/681-8100

Single $13.00 (1 dble. bed - 1 person)
Double $18.00 (1 dble. bed - 2 persons)
" $20.00 (2 dble. beds - 2 persons)

Gov't. rate extended to any person attending EPA Training Courses or EPA sponsored meetings.

Color TV, swimming pool (outdoor), room phone service, restaurant serving breakfast from 6:45 AM - 11 AM. Converts into cocktail lounge in evening.

Manager: Jim Huesing

NOTE: We recommend you checking the rate at the time you make your reservation in the event there has been a price increase. (Summer rates go into effect May 1.)

These hotels and motels are listed for your information to assist you in planning for your accommodations during your stay in Cincinnati while attending our training course, and does not imply endorsement by the Office of Water Program Operations, U. S. Environmental Protection Agency.

* REQUIRES TRANSFER TO SECOND BUS.

BUS SCHEDULE

BUS NO. 53 - AUBURN/CLIFTON

BUS NO. 78 - LOCKLAND/READING

BUS. NO. 53

Leave Sixth & Vine	Arrive St. Clair & Vine
AM	AM
7:18	7:36
7:41	7:59
8:03	8:21
8:25	8:43
8:46	9:04

BUS NO. 78

Leave Sixth & Vine	Arrive St. Clair & Vine
AM	AM
7:03	7:27
7:20	7:44
7:33	7:57
7:45	8:09
7:50	8:14

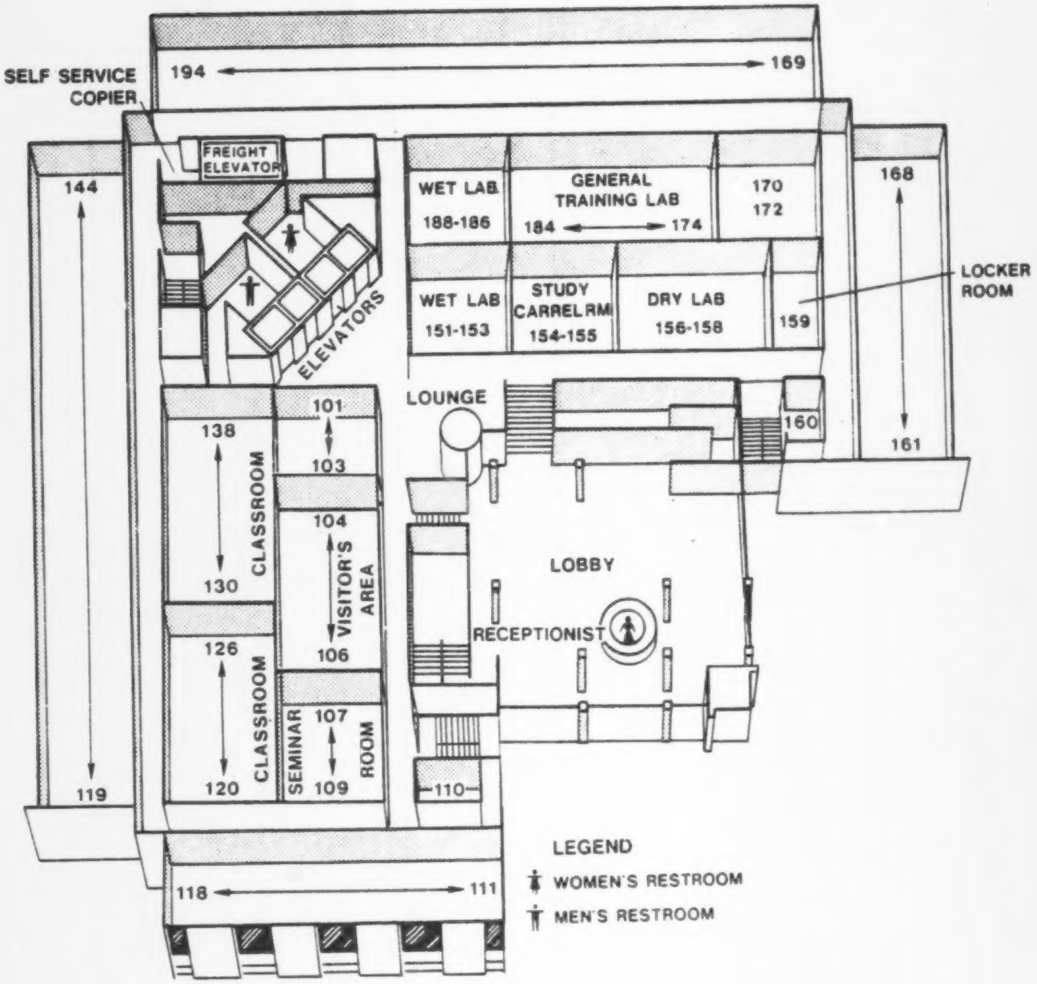
BUS NO. 53

Leave St. Clair & Vine	Arrive Sixth & Vine
PM	PM
12:30	12:48
1:02	1:20
1:33	1:51
2:05	2:23
2:36	2:54
2:58	3:16
3:21	3:39
3:41	4:02
4:04	4:25
4:28	4:49
4:52	5:13

BUS NO. 78

Leave St. Clair & Vine	Arrive Sixth & Vine
PM	PM
12:10	12:39
12:28	12:56
12:45	1:13
1:02	1:30
1:17	1:45
1:30	2:00
1:44	2:15
4:07	4:40
4:19	4:52
4:36	5:07
4:45	5:15

NOTE: The above two routes are the most direct routes to the Environmental Research Laboratory, 26 W. St. Clair Street, Cincinnati, Ohio. Information has been provided by the Queen City Metro. Times selected are those most apt to be used by students attending NTC Training Courses. Arrival times are approximate, and will vary because of road and traffic conditions.


SELF SERVICE COPIER
194
169
FREIGHT ELEVATOR
144
119
WET LAB
188-186
GENERAL TRAINING LAB
184
174
170
172
168
161
LOCKER ROOM
WET LAB
151-153
STUDY CARREL RM
154-155
DRY LAB
156-158
159
ELEVATORS
LOUNGE
160
101
103
138
130
CLASSROOM
104
106
VISITOR'S AREA
LOBBY
RECEPTIONIST
126
120
CLASSROOM
SEMINAR
107
109
ROOM
110
118
111
LEGEND
WOMEN'S RESTROOM
MEN'S RESTROOM

First Floor

SAMPLE

Course Title

Dates

REGISTRATION

INDIVIDUAL	WORD REC'D	APPL. REC'D	ACCEPT. SENT	COURSE INFO. SENT

SAMPLE

WAITING LIST

INDIVIDUAL	WORD REC'D	APPL. REC'D	ACTION TAKEN

SAMPLE

____
Course Title

____
Dates

Not Admitted
Lack of Space __________________ No Shows __________________

TRAINEE REGISTRATION RECORD
EPA-166 (CIN) (Rev. 4.73)

COURSE TITLE

DATES

COURSE NUMBER

NAME (*Last, First, M.I.*)

U.S. CITIZEN ☐ YES ☐ NO

IF NO, LIST FOREIGN COUNTRY

POSITION TITLE

LOCATION OF TRAINING

EMPLOYER (*Name, address, city, state, zip code*)

LOCAL RESIDENCE DURING COURSE

COURSE MODERATOR

	"X" ONE ITEM IN EACH CATEGORY ONLY	"X"
EMPLOYER CATEGORY	EPA	
	DI	
	DHEW	
	DEPT. OF DEFENSE	
	OTHER FEDERAL *	
	STATE GOVERNMENT	
	LOCAL GOVERNMENT	
	FOREIGN GOV'T	
	UNIV. FACULTY	
	UNIV. STUDENT	
	INDUSTRY	
	CONSULTANT	
	REGIONAL AGENCY	
	OTHER *	
	SPECIFY *	
YEARS OF PROFESSIONAL EXPERIENCE	0-1 YEARS	
	2-4	
	5-7	
	8-10	
	11-15	
	16-20	
	21 OR OVER	
PROFESSION OR OCCUPATION	ADMINISTRATOR	
	BIOLOGIST	
	CHEMIST	
	CIVIC ORGANIZATION*	
	CONSERVATIONIST	
	EDUCATOR	
	ENGINEER *	
	GEOLOGIST	
	MICROBIOLOGIST	
	OCEANOGRAPHER	
	PHARMACIST	
	SANITARIAN	
	STATISTICIAN	
	TECHNICIAN *	
	TREATMENT PLANT OPERATOR	
	OTHER *	
	SPECIFY *	
EDUCATION	HIGH SCHOOL NON-GRADUATE	
	HIGH SCHOOL GRADUATE	
	COLLEGE NON-GRADUATE 1-3 YEARS	
	COLLEGE NON-GRADUATE OVER 3 YEARS	
	BACHELOR DEGREE	
	MASTER DEGREE	
	DOCTOR DEGREE	
	OTHER (*describe*)	

COURSE SUMMARY RECORD
EPA 165 (CIN/). (Rev. 7.73)

LOCATION OF TRAINING

COURSE TITLE

COURSE DIRECTOR

COURSE MODERATOR

DATES

NO. OF TRAINEES

COURSE NUMBER

ITEM	TALLY	TOTAL	
EPA			EMPLOYER CATEGORY
DI.			
DHEW			
DEPT. OF DEFENSE			
OTHER FEDERAL			
STATE			
LOCAL			
FOREIGN GOV'T			
UNIV. FACULTY			
UNIV. STUDENT			
INDUSTRY			
CONSULTANT			
REGIONAL AGENCY			
OTHER			
0-1 YEARS			YEARS OF PROFESSIONAL EXPERIENCE
2-4			
5-7			
8-10			
11-15			
16-20			
21 OR OVER			
ADMINISTRATOR			PROFESSION OR OCCUPATION
BIOLOGIST			
CHEMIST			
CIVIC ORG.			
CONSERVATIONIST			
EDUCATOR			
ENGINEER			
GEOLOGIST			
MICROBIOLOGIST			
OCEANOGRAPHER			
PHARMACIST			
SANITARIAN			
STATISTICIAN			
TECHNICIAN			
TREAT PLANT OPER			
HS NON- GRAD			EDUCATION
HS GRAD			
COL 1-3 YEARS			
COL OVER 3 YEARS			
BACHELOR DEGREE			
MASTER DEGREE			
DOCTOR DEGREE			
EPA			
PAID			

BY STATE OR COUNTRY OF EMPLOYMENT		
AREA	TALLY	TOTAL
ALABAMA		
ALASKA		
ARIZONA		
ARKANSAS		
CALIF.		
COLO.		
CONN.		
DELAWARE		
D. C.		
FLORIDA		
GEORGIA		
HAWAII		
IDAHO		
ILLINOIS		
INDIANA		
IOWA		
KANSAS		
KY.		
LA.		
MAINE		
MD.		
MASS.		
MICHIGAN		
MINN.		
MISS.		
MISSOURI		
MONTANA		
NEBRASKA		
NEVADA		
N. H.		
N. J.		
N. MEXICO		
NEW YORK		
N. C.		
N. D.		
OHIO		
OKLA.		
OREGON		
PENN.		
R. I.		
S. C.		
S. D.		
TENN.		
TEXAS		
UTAH		
VERMONT		
VIRGINIA		
WASH.		
W. VA.		
WISC.		
WYOMING		

ROSTER OF PARTICIPANTS

Name and Address	Job Title/Position
1.	
2.	
3.	
4.	
5.	
etc.	

UNIT EQUIPMENT LISTS

INTRODUCTION

These lists are designed to aid the instructor in preparing for each of the unit laboratories. They are broken down into three sections; A-Capital Equipment; B-Reusable Supplies; C-Consumable Materials.

The items under Capital Equipment are the expensive items and may be shared by the students. It is always desirable to have a complete set of equipment for each student. However, this is not always practical. Care should be taken that each student perform the analysis. If students are arranged in groups, there will always be a doer and a watcher.

The reusable items can usually be purchased in sufficient quantities that each student has his own. The numbers listed should be multiplied by the number of students attending the course. Some items are marked as necessary only under certain procedures.

The last section, Consumables, lists the chemicals that are needed and gives a source for items that might be hard to find. These materials should be purchased in amounts that may supply the entire course and at least three to four courses in the future.

These sections are also included in the participants manual with the intention of assisting the student upon his return to his job should he wish to set up the analytical procedure.

LOCATION OF EQUIPMENT LISTS IN TRAINING MANUAL

Silver E6

Extraction Techniques for Cd, Cr, and Pb E7

Mercury E8

Arsenic and Selenium E9

Nitrate
  Cadmium Reduction E10.A
  Brucine E10.B

Fluoride
  SPADNS E11.A
  Electrode E11.B
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Barium E12

Measurement of Free Chlorine Utilizing the DPD Kit E13.B

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Organics
  Pesticides E20
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WATER MONITORING PROCEDURE: Determination of Ag+

General Description of Equipment and Supplies Used in the Process

A. Capital Equipment

1. Balance, analytical - sensitivity 0.1 milligram
2. Atomic absorption spectrophotometer and recorder
3. pH meter
4. Hot plate, 110 V

B. Reusable Supplies

1. Flasks, volumetric, 100 ml, 1000 ml
2. Pipets, volumetric, 50 ml, 3 ml, 1 ml
3. Reagent bottles, glass with glass stopper
4. Anion and cation exchange resin cartridges
5. Beakers, 150 ml
6. pH paper
7. Watch glass
8. Funnel, 80 mm diameter
9. Ring stand and 3 inch ring
10. Graduated cylinders 100, 50, 10 ml

C. Consumable Supplies

1. Reagents

   Silver Nitrate (analytical reagent grade)

WATER MONITORING PROCEDURE: Determination of Total Cadmium, Chromium and Lead by Atomic Absorption

Equipment and Supply Requirements

A. Capital Equipment:

1. Atomic absorption spectrophotometer: Any commercial atomic absorption instrument having an energy source, an atomizer burner system, a monochromator, and a detector is suitable
2. Balance, analytical with a 0.1 milligram sensitivity
3. Hollow cathode lamps - cadmium, chromium, lead
4. Hot plate, capable of holding at least ten 250 ml beakers
5. pH meter (optional), to adjust pH for test
6. Pressure regulator valves:
   - a. Two stage regulator designed to deliver acetylene with an inlet CGA 510 connector
   - b. Two stage regulator designed to deliver air with an inlet CGA 1340 connector
7. Recorder: One compatible with the electronics of the atomic absorption instrument is acceptable
8. Still - borosilicate glass distillation apparatus or another source of good distilled water
9. Stop watch

B. Reusable Supplies:

1. Beakers, 3 - 250 ml size, 3 (sample, spike, duplicate, standards)
2. Three dropper bottles - brown glass, 100 ml size
3. Four reagent bottles - clear glass, 1000 ml capacity
4. Cylinders - graduated
   1 1000 ml
   1 500 ml
   1 250 ml
   1 10 ml
   1 10 ml glass stoppered, wide base (sample, spike, duplicate, standard)
5. Flask, volumetric, glass stoppered
   5 1000 ml
   2 200 ml
   3 100 ml
6. Funnel, very small to filter 365 ml, glass
   1 (sample, spike, duplicate, standard)
7. Funnel, separatory, glass stoppered, teflon stopcock, 250 ml
   1 (sample, spike, duplicate, standard)
8. Pipets, graduated, mohr type
   1 5 ml
   2 10 ml
   Volumetric type
   4 1 ml
   2 2 ml
   1 3 ml
   4 5 ml
   5 10 ml
   1 50 ml
9. Instrument - manufacturer's operation manual on the atomic absorption

Equipment and Supply Requirements (Cont'd.)

10. Safety glasses
11. Separatory funnel rack
12. Wash bottle, plastic, squeeze type
13. Watch glasses, 1 (sample, spike, duplicate), 3.5 inches in diameter

C. Consumable:

1. Deionizing column - mixed bed type
2. Gases
   Fuel, acetylene (E_2H_2) - for use with the atomic absorption instrument, purified grade, 380 cf, CGA 510
   Oxidant, air - for use with the atomic absorption instrument, dry grade, 2200 cf, CGA size 1340
3. Filter paper - Whatman #42
4. Plastic weighing boats - about 12
5. Labels
6. Marking pencil
7. Reagents
   Pyrrolidine
   Ammonium hydroxide
   Nitric acid
   Hydrochloric acid
   Carbon disulfide
   Cadmium sulfate
   Chromium trioxide
   Lead nitrate
   Potassium permanganate
   Chloroform
   Sodium azide
   95% ethyl alcohol - if an indicator is to be used
   Bromophenol blue - indicator

WATER MONITORING PROCEDURE: Determination of Mercury Using the Flameless Atomic Absorption (Cold Vapor) Technique

Equipment and Supply Requirements

A. Capital Equipment:

1. Atomic absorption spectrophotometer - Any commercial atomic absorption instrument is suitable if it has an open burner head area in which to mount an absorption cell, and if it provides the sensitivity and stability for the analyses. Also instruments designed specifically for the measurement of mercury using the cold vapor technique are commercially available and may be substituted.
2. Mercury hollow cathode lamp
3. Recorder - Any multi-range variable speed recorder that is compatible with the UV detection system is suitable.
4. Absorption cell - See Figure 4. The cell is constructed from glass or plexiglas tubing 25.4 mm O.D. x 114 mm (Note 1). The ends are ground perpendicular to the longitudinal axis and quartz window (25.4 mm diameter x 1.6 mm thickness) are cemented in place. Gas inlet and outlet ports (6.4 mm diameter) are attached approximately 12 mm from each end. The cell is strapped to a support and aligned in the light beam to give maximum transmittance.
5. Analytical balance, 200 gram capacity
6. Trip balance, 500 gram capacity
7. Water bath, capable of maintaining 95°C temperature

B. Reusable Supplies:

1. Air pump - Any peristaltic pump, with electronic speed control, capable of delivering 1 liter of air per minute may be used. (Regulated compressed air can be used in an open one-pass system.)
2. Six BOD bottles (plus one bottle is needed per sample)
3. Volumetric flasks
   Six 1000 ml
   Four 100 ml
   One 250 ml
4. Pipets
   Five 10 ml graduated
   Two 1 ml graduated
   One 1 ml volumetric
   One 2 ml volumetric
   Three 10 ml volumetric
   One 5 ml volumetric
5. One 100 ml graduated cylinder; two 25 ml graduated cylinders
6. One Laboratory apron or coat
7. One pair safety glasses
8. One spatula
9. One pipet bulb
10. One wash bottle for distilled water
11. One glass stirring rod (about 6 inches long)

Note 1: An all glass absorption cell, 18 mm O.D. by 200 mm, with inlet 12 mm from the end, 18 mm O.D. outlet in the center, and with quartz windows has been found suitable.

Equipment and Supply Requirements (Continued)

12. One powder funnel
13. Rubber stoppers - two size #2 (for drying tube)
14. Fifteen feet of Tygon tubing
15. One glass tubing - 6 inches x 3/4 inch diameter
16. One Rotometer (any unit capable of measuring air flow of 1 liter/min.)
17. One set cork hole borers
18. One brush (for cleaning balance)

The following equipment is needed depending on which method is chosen to trap the mercury.

1. Liquid trap
   a. Straight glass frit, coarse porosity, such as Corning #404260
   b. Filtering flask, such as Corning #40058
   c. Rubber stopper, one hole to accept frit
   d. Reagents, $KMnO_4$ and H_2SO_4
2. Solid trap
   a. Activated carbon such as Barnebey and Cheney #580-13 or #580-22

      from: Barnebey and Cheney
      E. 8th Avenue & Cassidy Street
      Columbus, OH 43219

      or

      Coleman Instruments
      42 Madison St.
      Maywood, IL 60153
      Item #50-160

   b. Glassware - Can be assembled similar to the drying tube (Figure 3).
3. Closed System

   The following equipment is needed when using the closed system with a trap.

   a. Two position valve, or stopcock, such as Corning #442838
   b. Glass "Y" shaped tubing connecter
   c. Pinch clamp, type used for stopping flow in tubing

C. Consumable Supplies:

1. Sulfuric acid (H_2SO_4) concentrated
2. Nitric acid (HNO_3) concentrated
3. Potassium permanganate, $KMnO_4$
4. Potassium persulfate, $K_2S_2O_8$
5. Sodium chloride, NaCl

Equipment and Supply Requirements (Continued)

6. Hydroxylamine sulfate $(HONH_2) \cdot H_2SO_4$ or
   Hydroxylamine hydrochloride $NH_2OH \cdot HCl$
7. Stannous sulfate, $SnSO_4$ or stannous chloride, $SnCl_2$
8. Mercuric Chloride, $HgCl_2$
9. Hydrochloric acid concentrated
10. Magnesium perchlorate, $Mg(ClO_4)_2$ for drying tube, 20 g.
11. Distilled water
12. Sponges (for cleaning laboratory table tops)
13. Notebook for recording weights and readings
14. Two pieces of glass tubing (5 mm diameter, about two inches long) for the drying tube
15. Glass wool (for drying tube)
16. Plastic weighing boats (about 10)
17. Pen or pencil

WATER MONITORING PROCEDURE: Determination of Arsenic and Selenium

General Description of Equipment and Supplies Used in the Process

A. Capital Equipment:

1. Balance, analytical - sensitivity 0.1 milligrams
2. Atomic absorption spectrophotometer - see instrument section
3. pH meter
4. Hot plate, 110 V
5. Magnetic stirrer
6. Pan balance

B. Reusable Supplies:

1. Flasks, volumetric, 50 ml, 100 ml, 1000 ml
2. Flasks, Erlenmeyer, 250 ml
3. Pipet, volumetric, 25 ml 50 ml
4. Pipet, micro, 1 ml graduated 0.1 ml
5. Pipet, measuring, 1 ml, 10 ml
6. Graduated cylinders, 500 ml, 100 ml, 50 ml, 25 ml
7. Beakers, 250 ml
8. Funnel, 80 mm diameter
9. Ring stand and 3 inch ring
10. Watch glass
11. Anion and cation exchange resin cartridges
12. Reagent bottles
13. pH paper
14. Specialized glassware - See apparatus section

C. Consumable Supplies:

1. Reagents, analytical reagent grade
    - a. Arsenic trioxide
    - b. Selenium metal
    - c. Zinc metal (200 mesh)
    - d. Potassium iodide
    - e. Stannous chloride
    - f. Sulfuric acid 18N
    - g. Hydrochloric acid, concentrated
    - h. Nitric acid
    - i. Perchloric acid, 70-72 percent
    - j. Sodium hydroxide
2. Gases
    - a. Argon
    - b. Hydrogen

EFFLUENT MONITORING PROCEDURE: Determination of Nitrate-Nitrite Nitrogen and of Nitrate Nitrogen, Cadmium Reduction Method

Equipment and Supply Requirements

A. Capital Equipment:

1. Balance, analytical, 160 g capacity, precision ± 0.1 mg
2. Balance, triple beam, 500 g capacity, precision ± 0.25 g
3. pH meter/combination electrode, range 0-14 pH
4. Refrigerator, temperature range 2° - 10°C
5. Spectrophotometer, wave length range 325-825 nm
6. Still and de-ionizing cartridges (or other means of distilling and de-ionizing water)

B. Reusable Supplies:

1. One apron, laboratory
2. One 100 ml beaker
3. Four 250 ml beakers (3 for buffer solutions)
4. One 400 ml beaker
5. One 1 liter beaker
6. One 2 liter beaker
7. Two bottles, Barnes with stoppers and two droppers, small gauge
8. One 150 ml bottle, dropper
9. One 250 ml bottle, plastic wash
10. One 100 ml bottle, storage with screw-on cap (storage of 6N HCl)
11. Seven 1 liter bottles, storage, brown with screw-on caps or rubber stoppers
12. Two 5 gallon bottles, water with bottom spout
13. One brush, camel hair (cleaning analytical balance)
14. Two brushes, bottle (cleaning glassware)
15. One bulb, propipet type
16. One buret holder, double clamps (reduction column support)
17. Two columns, reduction (see Figure 1 at the end of this section)
18. Three cuvettes
19. One 25 ml cylinder, graduated
20. One 50 ml cylinder, graduated
21. One 100 ml cylinder, graduated
22. One 500 ml cylinder, graduated
23. One 1 liter cylinder, graduated
24. One 50 ml flask, volumetric with stopper (dilution of sample)
25. Twelve 100 ml flasks, volumetric with stoppers (for standards)
26. X 100 ml flasks, volumetric with stoppers (for samples - 1 flask per sample)
27. Twelve 250 ml flasks, Erlenmeyer with stoppers (for standards)
28. X 250 ml flasks, Erlenmeyer with stoppers (for samples-1 flask per sample)
29. One 1 liter flask, Erlenmeyer, or a large, empty chemical bottle (for Cd washings)
30. Three 1 liter flasks, volumetric with stoppers
31. Two 2 liter flasks, volumetric with stoppers
32. One filter funnel for 0.45 μ filter (turbidity removal)

EFFLUENT MONITORING PROCEDURE: Determination of Nitrate-Nitrite Nitrogen and of Nitrate Nitrogen, Cadmium Reduction Method

B. Reusable Supplies (Continued)

33. One funnel, powder
34. One funnel, large powder with large filter paper (for Cd washings)
35. One 250 ml funnel, separatory (oil and grease removal)
36. One pair glasses, safety
37. Two hoses, rubber, 3" strip, 4 cm I.D. with screw type clamp
38. One notebook (recording data)
39. Two 100 ml volumetric pipets (construction of reduction columns)
40. One 0.5 ml pipet, volumetric
41. One 1 ml pipet, volumetric
42. One 2 ml pipet, volumetric
43. One 5 ml pipet, volumetric
44. One 10 ml pipet, volumetric
45. One 25 ml pipet, volumetric
46. One 50 ml pipet, volumetric
47. One rod, stirring (6" or 12")
48. One sieve, 40 mesh
49. One sieve, 60 mesh
50. One spatula (scoopula)
51. Two stands, ring (support funnel, and reduction column)
52. One support, ring, small (support funnel)

C. Consumable Supplies:

1. Glasswool, wad
2. Membrane filter, 0.45 μ
3. Notebook (recording data)
4. Pen or pencil (recording data, marking flasks)
5. Soap
6. Sponges (for cleaning)
7. Tissues, soft (wiping cuvettes and electrodes)
8. Towels, paper
9. Twelve weighing boats
10. 26 g ammonium chloride, NH_4Cl

*11. 100 ml ammonium hydroxide, NH_4OH

*12. 150 ml buffer solution, STD pH 4
*13. 600 ml buffer solution, STD pH 7
*14. 450 ml buffer solution, STD pH 10
**15. 25 g cadmium granules, 40-60 mesh
16. 55 ml chloroform, $CHCl_3$

17. 20 g copper sulfate, pentahydrate, $CuSO_4 \cdot 5H_2O$

18. 3.4 g disodium ethylenediamine tetraacetate, $C_{10}H_{14}N_2Na_2O_8$

19. 1 g N-(1-napthyl) - ethylenediamine dihydrochloride, $C_{12}H_{14}N_2 \cdot 2HCl$

*20. 200 ml hydrochloric acid, concentrated, HCl
21. 100 ml hydrochloric acid, dilute (6N), HCl
22. 100 ml phosphoric acid, concentrated, H_3PO_4

*23. Potassium dichromate (cleaning solution), $K_2Cr_2O_7$

24. 7.218 g potassium nitrate, KNO_3

EFFLUENT MONITORING PROCEDURE: Determination of Nitrate-Nitrite Nitrogen and of Nitrate Nitrogen, Cadmium Reduction Method

C. Consumable Supplies (Continued)

25. 6.072 g potassium nitrite, KNO_2
26. 240 g sodium hydroxide, pellets, NaOH
27. 10 g sulfanilamide, $C_6H_8N_2O_2S$
*28. Sulfuric acid, concentrated, (cleaning solution) H_2SO_4
29. 100 g zinc sulfate, heptahydrate, $ZnSO_4 \cdot 7H_2O$
30. Labels, package, 1 1/2 x 1 inch
31. Paper, graph 8 1/2 x 11, package

All reagents should be reagent grade.

The above amounts do not allow for spillage or mistakes.

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*These amounts will vary

**This metal can be purchased from EM Laboratories, Inc., 500 Executive Boulevard, Elmsford, New York, 10523, Cat. 2001 cadmium, coarse powder

EFFLUENT MONITORING PROCEDURE: Determination of Fluoride in Potable and Waste Waters Using the SPADNS Colorimetric Procedure

Equipment and Supply Requirements

A. Capital Equipment:

1. Spectrophotometer, for use at 570 nm providing a light path of at least 1 cm. with cells.
2. Analytical balance; capable of weighing to 0.1 mg
3. Still or Ion Exchange column or other source of distilled water
4. Still for distilling sample - see EMP on Fluoride Distillation
5. Trip balance - 500 gram capacity

B. Reusable Supplies:

1. Beakers - 500 ml glass - 1 each
2. Flasks - Erlenmeyer - 125 ml - 8 each
3. Flasks - Erlenmeyer - 500 ml - 1 each
4. Flasks, volumetric - 50 ml - 8 each
5. Flasks, volumetric 100 ml - 2 each
6. Flasks, volumetric 1000 ml - 2 each
7. Graduated Cylinder - 500 ml - 1 each
8. Pipets, volumetric - 10 ml - 3 each
9. Pipets, volumetric - 50 ml - 8 each
10. Powder funnel - 1 each
11. Saftey glasses - 1 pair
12. Spatula - 1 each
13. Thermometer 0-100°C - 1 each
14. Wash bottle - plastic - 1 each

C. Consumable Supplies

1. SPADNS - Reagent 4.5-dihydroxy-3 [(p-sulfophenyl)azo-2.7 napthalene disulfonic acid, trisodium salt.

Baker Cat No. 5189	---	10 grams
Eastman Cat No. 7309	---	25 grams

2. Zirconyl chloride - Reagent $ZrOCl_2$

Baker Cat No. X720	---	500 grams
Fisher Cat No. Z-80	---	1 lb.

3. Sodium Fluoride-NaF-Reagent

Baker Cat No. 3688	---	1 lb.
Fisher Cat No. 5299	---	1/4 lb.

or

Sodium Fluoride Stock Solution

C. Consumable Supplies (continued)

3. Orion Research Inc. Cat No. 94-06-07

   Hach Chemical Co.

4. Sodium Arsenite $NaAsO_2$ Reagent

   Baker Cat No. 3487 --- 1 lb.

   Fisher Cat No. S-225 --- 1 lb.

5. Hydrochloric acid HCl Reagent

   Baker Cat No. 9535 --- 1 pt

   Fisher Cat No. A-144 --- 1 pt

6. Weighing boats-plastic disposable - 60 each
7. Pen or Pencil
8. Notebook

D. Addresses of Suppliers Mentioned

J. T. Baker, Chemical Co.
1 Public Square
Cleveland OH 44113

Eastman Organic Chemicals
Eastman Kodak Co.
1187 Ridge Road W.
Rochester, NY 14650

Fisher Scientic Co.
5481 Creek Rd.
Cincinnati, OH 45242

Hach Chemical Co.
P. O. Box 907
Ames, Iowa 50010

Orion Research Inc.
380 Putnam Ave.
Cambridge, MA 02139

EFFLUENT MONITORING PROCEDURE: Determination of Fluoride in Potable and Waste Waters Using a Selective Ion Electrode

Equipment and Supply Requirements

A. Capital Equipment:

1. Expanded scale pH meter or selective ion meter

   Examples: Beckman: Expandomatic Model 76007
   Coleman: Model 37A
   Corning: Model 12
   Fisher Accumet Model 320
   Leeds & Northrup Model 7405 - A 2.
   Orion Model 407A portable
   Hach pH/Fluoride meter No. 12330
   No. 12320 - portable

2. Sleeve-type reference electrode

   Examples: Beckman: No. 40463
   Coleman: No. 3-721
   Corning: No. 476012
   Fisher: No. 13-639-62
   Orion: No. 90-01

3. Fluoride Electrode

   Example: Beckman: 39600
   Coleman: 3-803
   Corning: 476042
   Orion: 94-09
   Orion: 96-09
   Hach: 13034-00

4. Trip balance, 500 gram capacity.

5. Magnetic stirer and teflon covered stir bar, about 2.5 cm long.

6. Water still or other source of distilled water.

B. Reusable Supplies:

1. One stop watch, clock or watch (with second hand).
2. One thermometer, glass 0 to 100°C.
3. One plastic squeeze bottle
4. One stirring rod, glass about 10 inches long.
5. One pair, safety glasses
6. One powder funnel, glass about 3 inch diameter
7. One laboratory apron
8. Five weighing boats, plastic (2-3 inches square).
9. One note book (for recording data)
10. One pen or pencil
11. One Flask volumetric 1000 ml volume.
12. Two Flask volumetric 100 ml volume
13. Ten Flasks 50 ml volume (for use with pH meter only)
14. One Cylinder graduated 500 ml volume
15. One Cylinder graduated 100 ml volume
16. Seven Pipet volumetric 10 ml
17. Two Pipet graduated 10 ml
18. Four Beakers, plastic 100 ml volume
19. One Pipet Bulb
20. One spatula

The following will be needed in addition to the above only if the buffer is prepared rather than purchased.

21. One Erlenmeyer flask, 500 ml volume
22. One Beaker, 1000 ml volume
23. One Flask volumetric, 1000 ml volume
24. One pH electrode

C. Consumable Supplies:

1. a. Sodium Fluoride -NaF Reagent grade powder - 4 oz.or
   b. Sodium Fluoride Stock Solution -
   Orion Research Inc. 380 Putnam Ave. Cambridge, Mass 02139, Cat. No. 94-06-07
   Hach Chemical Co. P.O. Box 907 Ames Iowa, 50010, Cat. No. 232-11

2. Adjustment buffer

   a. Total Ionic Strength Adjustment Buffer (TISAB)
   Orion Research Inc. 380 Putnam Ave. Cambridge, Mass. 02139 Cat. No. 94-09-09

   b. Fluoride Adjustment Buffer, Formula - 2589
   Hach Chemical Co. P.O. Box 907 Ames Iowa, 50010 Powder - Cat. No. 2589.01
   Pillows - Cat. No. 2589-99

C. Consumable Supplies (Continued):

3. The following are needed if the adjustment buffer is prepared instead of purchased.

   a. Acetic Acid, Glacial, CH_3COOH. Reagent grade - 1 pt
   b. CDTA* (1,2. cyclohexylene dinitrilotetraacetic acid) 25 g. Matheson, Coleman & Bell Cat. No. CX - 2390
   c. Sodium Chloride, NaCl, Reagent grade - 1 pound
   d. Sodium Hydroxide, NaOH, Reagent grade - 1 pound

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* Also listed as 1,2 cyclohexylene diaminetetraacetic acid Baker Cat. No. G083.

WATER MONITORING PROCEDURE: Preliminary Distillation Procedure for Fluoride Analysis of Potable and Wastewaters

Equipment and Supply Requirements

A. Capital Equipment:

Water still or other source of distilled water

B. Reusable Supplies:

1. One adaptor - offset with outer ground glass joint 24/40 at top and inner ground glass joint 24/40 at the bottom, with opening with rubber glove connector for thermometer.
2. One burner, natural - gas type (or for other type gas used in lab)
3. One boiling flask - 1 liter, Pyrex or Kimax, round bottom, with 24/40 outer ground glass joint
4. Two clamps - to hold boiling flask and condenser to ring stand. One should be covered with asbestos or fiberglas to withstand heat.
5. One condenser - 40 cm long, double jacket, outer ground glass 24/40 joint at top
6. One connecting tube - with two inner ground glass 24/40 joints
7. One cylinder - volumetric, 500 ml
8. One flask - Erlenmeyer, 300 ml
9. Twelve glass beads - (not hard glass, i.e., Pyrex or Kimax)
10. One tube grease - silicone stopcock
11. One ring stand and rod
12. One thermometer - 0 to 200°C, 24" long
13. Tubing, Tygon - enough to reach water supply and drain

C. Consumable:

1. Distilled water - about 6 liters
2. Silver sulfate - crystals (for removal of chloride concentration greater than 2000 mg/l)
3. Sulfuric acid
4. Detergent

WATER MONITORING PROCEDURE: Determination of Barium (BA^{++})

Equipment and Supply Requirements

A. Capital Equipment:

1. Atomic absorption spectrophotometer
2. Recorder - compatible with the instrument
3. Nitrous oxide burner head
4. Barium - hollow cathode lamp
5. Pressure regulators two stage for
   Acetylene - CGA inlet 510 connector
   Air - CGA inlet 1340 connector
   Nitrous oxide - CGA inlet 1320 connector
6. Balance - analytical with a 0.1 milligram sensitivity
7. Still - borosilicate glass or equivalent

B. Reusable Supplies:

1. Trip balance - 100 gram capacity
2. Pen or pencil
3. Twelve inch ruler
4. Hot plate
5. Five reagent bottles - clear glass, glass stoppered 500 ml cap
6. Six beakers - glass, 150 ml size
7. Six cylinders - graduated, 100 ml size
8. Three flasks - volumetric, 1000 ml volume
9. Six flasks - volumetric, 100 ml volume
10. One pipet - graduated, 1 ml
11. Two pipets - graduated, 10 ml
12. One pipet - volumetric, 1 ml
13. Two pipets - volumetric 5 ml
14. One pipet - volumetric 10 ml
15. One pipet - volumetric 20 ml
16. One funnel - powder, glass
17. One funnel - filtering
18. Pipet bulb
19. Safety glasses
20. Wash bottle - plastic

Consumable Supplies:

1. Deionizing column - mixed bed type
2. Gases
   Acetylene - purified or commercial grade
   Air - dry grade
   Nitrous oxide - technical grade
3. Detergent
4. Nitric Acid - ACS grade
5. Hydrochloric acid - ACS grade
6. Barium chloride
7. Potassium chloride

WATER MONITORING PROCEDURE: Determination of Barium (BA^{++})

Equipment and Supply Requirements (Continued)

8. pH paper - capable of measuring pH 2 (pHydrion)
9. Filter paper - Whatman #42
10. Graph paper
11. Wax marking pencil
12. Plastic weighing boats, ∿ 12 each

WATER MONITORING PROCEDURE: Measurement of Free Chlorine Utilizing the DPD Kit

Equipment and Supply Requirements

A. Capital Equipment:

Analytical balance capable of weighing to 0.1 mg (.0001 g) under a 200 g load.

B. Reusable Supplies:

1. Chlorine Test Kit (DPD method) such as:
   a. Model CN-66
   Hach Chemical Company
   PO Box 907
   Ames, IA 50010

   b. Model LP-1
   LaMotte Chemical Products Company
   Chestertown, MD 21620

2. Eight beakers, 50 ml size
3. Two flasks, volumetric with stoppers, 1000 ml size
4. Ten flasks, volumetric with stoppers, 100 ml size
5. One pipet, volumetric, 100 ml size
6. One pipet, volumetric, 50 ml size
7. One pipet, volumetric, 20 ml size
8. Three pipets, volumetric, 10 ml size
9. One dropper bottle, 100 ml size
10. Two rubber stoppers - to fit comparator cells (if stoppers are not supplied by manufacturer)

C. Consumable Supplies:

1. Distilled water, about 1 gal. or 3.8 liters
2. Graph paper, arithmetic, 10 x 10 divisions
3. Pencil or pen
4. Wash bottle, plastic squeeze type
5. Weighing boat, plastic, disposable
6. Potassium Permanganate ($KMnO_4$)
7. Potassium Iodide Crystals (KI)
8. Sodium Arsenite ($NaAsO_2$)
9. DPD - Reagent (Usually a supply is provided with the kit.)

WATER MONITORING PROCEDURE: Determination of Turbidity

Equipment or Supply Requirements

A. Capital Equipment:

1. Turbidimeter, Nephelometric - see list of acceptable instruments meeting the following criteria:
    a. Light source - Tungsten lamp operated at not less than 85% of rated voltage or more than rated voltage.
    b. Distance traveled by incident light and scattered light within the sample tube: total not to exceed 10 cm.
    c. Angle of light acceptance of the detector: centered at 90° to the incident light path and not to exceed ± 30° from 90°.
    d. Maximum turbidity to be measured: 40 units.

Acceptable Instruments*

- Hach Model 2100 Model 2100 A	Hach Chemical Co., 713 S. Duff Ave., PO Box 907, Ames, IA 50010
- HF Instruments Model DRT- 15 -100 -150 -200	HF Instruments, ltd.[+], 105 Healey Rd., Bolton, Ontario, Canada
- Turner Model 40-002 (for drinking water) 40-005 (for waste waters)	Turner Designs, 2247A Old Middlefield Way, Mountain View, CA 94043

- Bausch & Lomb - An attachment for their "Spectronic mini 20" Spectrophotometer. This can be obtained from any company that sells Bausch and Lomb Spectrophotometers.

2. Trip balance (or platform) or analytical balance: with 0.01 gram sensitivity
3. Distillation equipment - all glass still or ion exchange cartridges
4. Standard Turbidity Suspensions (optional) - if none supplied with the instrument

B. Reusable Supplies:

1. One brush, bottle
2. One flask, side arm filtering, 500 ml size
3. Six flasks, volumetric, 100 ml size with stoppers
4. One funnel, membrane filter funnel and holder
5. Two pipets, volumetric, 5 ml size
   Three pipets, volumetric, 10 ml size
6. Pipet bulb
7. Wash bottle, squeeze type, 500 ml

[+] Also sold by: Fisher Scientific Co., 711 Forbes Ave., Pittsburgh, PA 15219

*This list is not meant to be complete. It covers those known by the author at the time of writing this material.

WATER MONITORING PROCEDURE: Determination of Turbidity

C. Consumable Supplies:

1. Distilled water
2. Detergent
3. Membrane filters, 0.45 micron pore size
4. Tissues
5. Weighing boats, plastic disposable, about 12
6. Reagents

Hexamethylenetetramine, reagent grade - can be purchased from:

J. T. Baker Chemical Co.	Cat. No. N145
Fisher Scientific	Cat. No. H289
MC/B or Sargent-Welch	Cat. No. HX-0280
A. H. Thomas Co.	Cat. No. C389

Hydrazine Sulfate, Reagent grade - can be purchased from:

J. T. Baker	Cat. No. 2177
Fisher Scientific	Cat. No. H-320
MC/B or Sargent-Welch	Cat. No. HX-0575
A. H. Thomas Co.	Cat. No. C393

WATER MONITORING PROCEDURE: Determination of Chlorinated Hydrocarbon Pesticides

Equipment and Supply Requirements

A. Capital Equipment:

1. Gas Chromatograph equipped with
   a. Glass lined injection port
   b. Electron capture detector - tritium or nickel 63
   c. Recorder - potentiometric strip chart (10 in - 25 cm) compatible with the detector
2. Gas Chromatographic Column (best purchased from gas chromatographic supply house)
   a. Tubing - Pyrex (180 cm long (6 ft.) x 4mm ID)
   b. Glass Wool - Silanized
   c. Solid Support - Gas Chrom Q (100 - 120 mesh)
   d. Liquid Phase - Expressed as weight percent coated on solid support
      1) OV-1, 3%
      2) OV-210, 5%
      3) OV-17, 1.5% plus QF-1, 1.95%
      4) QF-1, 6% plus SE-30, 4%
3. Hot Water Bath - Capable of keeping temperature at 50° - 100° C
4. Source of high quality distilled water
5. Rotometers - If the instrument is not equipped with meters to monitor the flows of gases, these should be purchased as options
6. Analytical Balance - With a 0.1 milligram sensitivity
7. Trip or Platform Balance - With a 0.1 or 0.01 gram sensitivity
8. Oven - Capable of maintaining 130° C
9. Stop Watch - Capable of measuring at least 1/2 hour, the 60 second cycle divided to 1/5 second
10. Cylinder of Argon-methane (95 + 5%) for use with pulsed mode detector OR Nitrogen - Purified grade, moisture and oxygen free, for use with a DC mode detector
11. Pressure Regulator - Two stage with a CGA 580 fitting for Nitrogen or a CGA 350 fitting for Argon-methane
12. Filter - For carrier gas - molecular sieve type
13. Micro Syringes - 5, 10, 50 μl sizes
14. pH Meter - With pH electrode

Equipment and Supply Requirements (Continued)

15. Magnetic Stirrer with Teflon coated bar

16. Oven (optional) - Forced air capable of heating to 400° C

17. Trap - for oxygen

B. Reusable Supplies:

1. Beaker, 150 ml - One for each sample - duplicate - blank
2. Beaker, 500 ml - One for each sample - duplicate - blank
3. Buret, 10 ml graduations - One
4. Buret, 25 ml graduations - One
5. Chromatographic Column - Chromaflex (400 mm long x 19 mm ID) with coarse fritted plate on the bottom and Teflon stopcock and a 250 ml reservoir bulb at the top of the column with a flared out funnel shape at the top of the bulb, (special order Kontes Glass - K-420540-9011) - One for each sample - duplicate - blank
6. Chromatographic Column - Pyrex (about 400 mm long x 20 mm ID) with coarse fritted plate on bottom - One for each sample - duplicate - blank
7. Cylinders, graduated
   10 ml - One
   50 ml - Three
   100 ml - Two
   250 ml - Two
   1000 ml - One
8. Dropper Bottle, with dropper, 75 ml - One
9. Flasks, Erlenmeyer
   25 ml, glass stoppered - One
   125 ml, glass stoppered - Two
   250 ml, glass stoppered - One
   500 ml, glass stoppered - One
   1000 ml, glass stoppered - One for each sample - duplicate - blank
10. Flasks, volumetric
    10 ml - Five
    100 ml - Three
    500 ml - Three
11. Funnels, Separatory, with Teflon stopcock, 200 ml - One for each sample - duplicate - blank
12. Glassware, Kuderna-Danish (K-D), order from Kontes Glass Company
    a. Concentrator Tube, 10 ml calibrated, $\bar{\mathrm{S}}$ joint 12/22 female, #K570050, Size 1025
    b. Snyder Column, three ball, 150 mm long, #K503000, Size 121
    c. Snyder Column, one ball, 150 mm long, #K569001, Size 1/19
    d. Flask, 500 ml volume, #K570001
    e. Stoppers for flask, $\bar{\mathrm{S}}$ Size 19/22, #K850500
       One for each sample - duplicate - blank
13. Pipets, graduated
    1 ml - Two
    10 ml - One

WATER MONITORING PROCEDURE: Determination of Chlorinated Hydrocarbon Pesticides

Equipment and Supply Requirements (Continued)

14. Pipets, volumetric
    1 ml - One
    5 ml - One
    10 ml - Two
    20 ml - One
15. Reagent Bottles, glass, glass stoppered
    100 ml - One
    500 ml - Four
    1000 ml - One
16. Ring stand with ring and clamp and base - One for each sample - duplicate - blank
17. Ruler, divided in millimeters, about 30 cm long
18. Stirring Rod, glass, 12 in. long
19. Safety Glasses
20. Bottle, glass, wide-mouth, with glass stopper, 500 ml - One
21 Desiccator

C. Consumable Supplies:

1. Alcohol, ethyl, U.S.P. or absolute, neutralized to phenolphthalein (see Reagent Preparation Section)
2. Ethyl ether, Nanograde, pesticide quality
3. Florisil, PR Grade (60-100 mesh), purchase activated at 1250° F. Store in the dark in glass containers
4. Hexane, Nanograde, distilled in glass
5. Lauric Acid, purified, CP
6. Methylene Chloride, Nanograde, distilled in glass
7. Pesticide Standards, reference grade
8. Petroleum Ether, (boiling range 30-60° C) Nanograde (98+ % pure)
9. Phenolphthalein Indicator
10. Soap Solution, any liquid soap mixed 1:1 with water
11. Sodium Hydroxide, ACS
12. Sodium Sulfate, ACS, Granular, anhydrous
13. Sulfuric Acid, ACS
14. Distilled Water
15. Weighing Boats, plastic disposable
16. Chart Paper, for the recorder
17. Notebook, bound
18. Paper, graph

WATER MONITORING PROCEDURE: Determination of Chlorinated Phenoxy Acid Herbicides

Equipment and Supply Requirements

A. Capital Equipment:

1. Gas chromatograph equipped with
    - a. Glass lined injection port
    - b. Electron capture detector - tritium or nickel 63
    - c. Recorder - potentiometric strip chart (10 in.-25 cm) compatible with the detector
2. Gas chromatographic column (best purchased from gas chromatographic supply house)
    - a. Tubing - Pyrex (180 cm long (6 ft.) x 4 mm ID)
    - b. Glass wool - silanized
    - c. Solid support - gas chrom Z (100-120 mesh)
    - d. Liquid phase - expressed as weight percent coated on solid support
        - 1) OV-210, 5%
        - 2) OV-17, 1.5% plus QF-1, 1.95%
3. Hot water bath - capable of keeping temperature at 50°-100° C
4. Source of high quality distilled water
5. Rotometers - If the instrument is not equipped with meters to monitor the flows of gases, these should be purchased as options.
6. Analytical balance - with a 0.1 milligram sensitivity
7. Trip or platform balance - with a 0.1 or 0.01 gram sensitivity
8. Oven - capable of maintaining 130° C
9. Stop watch - capable of measuring at least 1/2 hour, the 60 second cycle divided to 1/5 second
10. Cylinder of Argon-methane (95 + 5%) for use with pulsed mode detector OR Nitrogen - purified grade, moisture and oxygen free, for use with a DC mode detector
11. Pressure regulator - two stage with a CGA 580 fitting for nitrogen or a CGA 350 fitting for Argon-methane
12. Filter - for carrier gas, molecular sieve type
13. Micro syringes - 5, 10, 50 µl sizes
14. pH meter (optional)

Equipment and Supply Requirements (Continued)

15. Desiccator
16. Muffle furnace (optional) - capable of heating to 400° C
17. Source of Vacuum
18. Trap for oxygen

B. Reusable Supplies:

1. Beaker - 100 ml, 1/sample, duplicate, blank, standard
2. Cylinders, graduated

   2, 25 ml
   2, 100 ml
   1, 250 ml
   1, 1000 ml

3. Cylinder, graduated - glass-stoppered

   1-25 ml/sample, duplicate, blank, standard

4. Flasks, Erlenmeyer

   1, 125 ml/sample, duplicate, blank, standard
   1, 250 ml/sample, duplicate, blank, standard
   1, 1000 ml/sample, duplicate, blank, standard
   Erlenmeyer - glass-stoppered
   1, 250 ml/sample = $ 19/22

5. Flasks - volumetric

   4, 100 ml
   6, 10 ml

6. Funnel, 1 - 50 mm diameter top/sample, duplicate, blank, standard
7. Funnel - separatory (with Teflon stopcock)

   1, 2000 ml/sample, duplicate, blank, standard
   1, 60 ml/sample, duplicate, blank, standard

8. Glass stirring rod, about 10 cm long
9. Glassware brush

WATER MONITORING PROCEDURE: Determination of Chlorinated Phenoxy Acid Herbicides

Equipment and Supply Requirements (Continued)

10. Kuderna-Danish (K-D), order from Kontes Glass Corporation

    5 plus 2/sample, concentration ampul, 10 ml calibrated $ 19/22 female
        #K5-70050, size 1025
        1/sample, Snyder col., three section, 150 mm long, #K503000, size 121
        1/sample, Snyder col., one section, #K569001, size 1-19
        1/sample, flask, 250 ml size, #K570001
    About 6/pr., springs, 2/set-up, #K662750
    1/ampul, stoppers for concentrator ampul, #K850500, size 19/22

11. Pipets

    1 box, Pasteur, disposable (140 mm long x 5 mm ID)
    4 - graduated, 1 ml
    5 - volumetric, 1 ml
    3 - volumetric, 2 ml
    2 - volumetric, 10 ml

12. Pipet bulb

    3 ml size for Pasteur type pipets
    Rubber type for pipets

13. Reagent bottles (glass-stoppered, storage)
    5 - 150 ml size
    1 - 500 ml size
    1 - 1000 ml size

14. Rack for separatory funnel

15. 3 - ring stand and clamp

16. 1 ruler - divides in millimeters

17. Safety glasses

18. 1 timer (60 min.)

C. Consumable Supplies

1. 1 box aluminum foil

2. 1 bottle - boiling stones (rinse with hexane)

3. 1 box detergent

4. 25 liters distilled water

5. 1 box glass wool (filtering grade, acid washed)

Equipment and Supply Requirements (Continued)

6. 1 pack graph paper (arithmetic, 10 x 20)
7. 1 roll pH paper (for acid pH)
8. 12 labels
9. 1 note book (bound)
10. 1 pencil or pen
11. 12 weighing boats, plastic, disposable
12. 1 bottle soap solution (any liquid soap mixed with water)
13. Chart paper for records
14. Reagents
    a. Acetone - ACS grade
    b. Alcohol - ethenol, 95%, ACS grade
    c. Benzene - nanograde, distilled in glass
    d. Borontrifluoride - methanol, esterification reagent, 14% BF_3 by weight*
    e. Ethyl ether - nanograde, distilled in glass
    f. Florisil - pesticide residue grade (60-100 mesh), purchase activated at 1250° F and store at 130° C
    g. Herbicide standards, reference grade
    h. Hexane, nanograde, distilled in glass
    i. Potassium hydroxide (KOH), ACS grade
    j. Potassium iodide (KI), ACS grade
    k. Sodium sulfate, ACS, granular
    l. Sulfuric acid, ACS, concentrated

*Available already prepared from: Applied Sicence Laboratories
PO Box 440
State College, PA 16501

COURSE MODIFICATION

The basic aim of this course is to teach the methods of analysis for the contaminants set down in the National Interim Primary Drinking Water Regulations. Under most circumstances all the contaminants should be covered. It is anticipated that the majority of individuals attending this course are representatives of State or private laboratories or from larger treatment plants. If this is true, these individuals will be doing all the analysis. Therefore, each contaminant needs to be covered.

This leads to two possible modes of modification. First, to offer all methods with laboratory time for each could prove to be too large an undertaking at one time. Therefore, the inorganic and organic could be separated. Example agendas for both these possibilities have been inserted in Section D. Another choice would be to select certain units and offer a combined organic-inorganic course not covering all methods. An example agenda has also been prepared for this possibility. All the methods have been prepared as separate units which can be pulled out of context and presented in any manner the instructor/director wishes. There is also the choice of presenting a two week course and in order to cover this the inorganic and organic agendas could be combined.

The second possibility for course modification is in the area where a choice of methods has been given, i.e., in the nitrate and fluoride procedures. Here a laboratory may already have chosen which method it will use. Consequently, this will allow the second method to be omitted.

Several of the contaminants may be grouped under a common heading and treated as one. For example, both arsenic and selenium can be covered as one under the topic of the gaseous hydride method. Barium and silver while using different oxidants could be covered as one topic under direct aspiration. Cadmium, chromium and lead may be grouped under a heading of metal needing extraction procedures before analysis. However, caution should be taken here because sufficient differences exist as to constitute major differences.

The additional topics listed offer a possibility for flexibility. These topics - Sampling, Reporting, Quality Control, An Explanation of the Safe Drinking Water Act, and the Atomic Absorption Techniques should be included. However, if sufficient information exists to show the instructor that one or more of these topics are not needed they may be adjusted accordingly.

Perhaps the best possibility for modification lies in the technique of offering the Units as individual portions at night or short periods of time during the day. These periods could be allocated toward a lecture covering the topic and the next session devoted to the laboratory for the same topic. This routine could be continued until all necessary items have been covered.

COMBINED ORGANICS-INORGANICS METHODOLOGY
One Week
Agenda

Day & Time	Subject
Monday	
8:30- 8:45	Registration
8:45- 9:15	Course Objectives and Pre-Test
9:15- 9:30	Break
9:30-10:45	Regulations Concerning the SDWA (Primary and Secondary Revisions of Changes in State Regulations - Alternate Methods)
10:45-11:30	Federal (State) Role in the Act
11:30-12:30	Lunch
12:30- 2:00	Laboratory Certification
2:00- 2:15	Break
2:15- 3:30	Sampling
3:30- 4:30	Discussion
Tuesday	
8:30-10:00	Nitrates & Fluorides
10:00-10:15	Break
10:15-11:15	Extraction of Pb, Cd, Cr
11:15-12:00	Direct Aspiration of Ag & Ba
12:00- 1:00	Lunch
1:00- 2:00	Furnace & Gaseous Hydride Determination of Arsenic & Selenium
2:00- 2:15	Break
2:15- 4:30	Laboratory: Nitrate Determination
Wednesday	
8:30- 9:30	Mercury Determination
9:30- 9:45	Break
9:45-12:30	Laboratory: A-Extraction of Pb, Cd, Cr B-Furnace & Direct Aspiration
12:30- 1:30	Lunch
1:30- 4:30	Laboratory: A-Furnace & Direct Aspiration B-Extraction of Pb, Cd, Cr
Thursday	
8:30-10:30	Extraction of Pesticides & Herbicides
10:30-10:45	Break
10:45-12:15	Determination of Trihalomethanes
12:15- 1:15	Lunch
1:15- 4:30	Laboratory: Extraction of Pesticides
Friday	
8:30-12:00	Laboratory: Gas Chromatographic Determination of Pesticides
12:00- 1:00	Lunch
1:00- 1:45	Residual Chlorine & Turbidity
1:45- 2:30	Safety
2:30- 3:30	Course Closing (Post Test)

INORGANIC METHODOLOGY COURSE
One Week
Agenda

Day & Time	Subject
Monday	
8:30- 9:00	Registration
9:00- 9:30	Course Objectives and Pre-Test
9:30- 9:45	Break
9:45-11:00	Regulations Concerning the SDWA
11:00-11:45	Federal (State) Role in the Act
11:45-12:45	Lunch
12:45- 2:00	Sampling, Handling and Preservation
2:00- 3:30	Laboratory Certification
3:30- 4:30	Nitrate Determination
Tuesday	
8:30- 8:45	Laboratory Briefing
8:45-11:45	Laboratory: A-Cadmium Reduction B-Brucine
11:45-12:45	Lunch
12:45- 4:00	Laboratory: A-Brucine B-Cadmium Reduction
4:00- 4:30	Discussion
Wednesday	
8:30- 9:30	Determination of Ba & Ag
9:30- 9:45	Break
9:45-10:45	Determination of Fluoride
10:45-12:45	Laboratory: A-Determination of Ba & Ag B-Determination of Fluoride
12:45- 1:45	Lunch
1:45- 4:00	Laboratory: A-Determination of Fluoride B-Determination of Ba & Ag
4:00- 4:30	Discussion
Thursday	
8:30- 9:30	Determination of Mercury
9:30- 9:45	Break
9:45-10:45	Determination of Pb, Cd, and Cr
10:45-11:45	Determination of As & Se
11:45-12:45	Lunch
12:45- 3:00	Laboratory: A-Determination of Mercury B-Determination of Pb, Cd & Cr (extraction)
3:00- 4:00	Residual Chlorine & Turbidity
4:00- 4:40	Discussion
Friday	
8:30-11:00	Laboratory: A-Determination of Pb, Cd, and Cr
11:00-11:45	Safety
11:45-12:45	Course Closing & Post-Test

ORGANIC METHODOLOGY COURSE
One Week
Agenda

Day & Time	Subject
Monday	
8:30- 3:30	Same as the Inorganic Methodology Course
3:30- 4:30	Gas Chromatography
Tuesday	
8:30-10:00	Pesticide Analysis
10:00-10:15	Break
10:15-11:30	Chlorophenoxy Analysis
11:30-12:30	Lunch
12:30- 4:30	Laboratory: A-Pesticide Extraction B-Chlorophenoxys Extraction
Wednesday	
8:30-12:00	Laboratory: A-Chlorophenoxys Extraction B-Pesticide Extraction
12:00- 1:00	Lunch
1:00- 4:30	Laboratory: A-Gas Chromatographic Analysis of Pesticides B-Gas Chromatographic Analysis of Chlorophenoxys
Thursday	
8:30-12:30	Laboratory: A-Gas Chromatographic Analysis of Chlorophenoxys B-Gas Chromatographic Analysis of Pesticides
12:30- 1:30	Lunch
1:30- 2:30	Determination of Trihalomethanes
2:30- 3:30	Course Closing & Post-Test

SUGGESTED EVENING SCHEDULE
FOR
COMBINED ORGANICS-INORGANICS METHODOLOGY
TWICE WEEKLY FOR TWO HOURS

FIRST WEEK

Tues:	7:00 - 8:00	Regulations Concerning the Safe Drinking Water Act
	8:00 - 9:00	Direct Aspiration Techniques
Thurs:	7:00 - 9:00	Laboratory: Direct Aspiration of Ag & Ba

SECOND WEEK

Tues:	7:00 - 8:00	Federal (State) Role in the Act
	8:00 - 9:00	Extraction Techniques for Cd, Cr, Pb
Thurs:	7:00 - 9:00	Extraction Techniques

THIRD WEEK

Tues:	7:00 - 8:00	Laboratory Certification
	8:00 - 9:00	Quality Control
Thurs:	7:00 - 9:00	Lecture on Determination of Pesticides and Herbicides

FOURTH WEEK

Tues:	7:00 - 9:00	Extraction and Clean-up for Pesticides
Thurs:	7:00 - 9:00	Gas Chromatography of Pesticides

FIFTH WEEK

Tues:	7:00 - 9:00	Lecture on Determination of As & Se by Furnace & Gaseous Hydride
Thurs:	7:00 - 9:00	Laboratory Demonstration - Furnace & Gaseous Hydride Techniques

SIXTH WEEK

Tues:	7:00 - 8:00	Sample Handling, Collection and Preservation
	8:00 - 9:00	Determination of Mercury
Thurs:	7:00 - 8:00	Nitrates
	8:00 - 9:00	Fluorides

SEVENTH WEEK

Tues:	7:00 - 8:00	Chlorine and Turbidity
	8:00 - 9:00	Review
Thurs:	7:00 - 9:00	Course Closing and Post-Test

INSTRUCTOR UNIT DESCRIPTIONS

INTRODUCTION

As has been mentioned, the goal of this course is to convey to the participant the correct analytical techniques to be used in analyzing for the chemical contaminants found in drinking water. All public water supplies are required to carry out these analysis periodically. One particular type of analysis, i.e., atomic absorption, is beyond most small public supplies because of the cost involved. Depending on how a state has elected to carry out primacy, the analysis might be done by the state laboratory or, small supplies might have to contract with a private laboratory for this analytical service. Because of this, most individuals who attned this course will be interested in learning how to test for all contaminants. Consequently, all methods should be covered.

This rationale makes it doubly important that you, as an instructor, carefully screen all applicants to determine what interests the students who will attend have. This will be a clue as to how you may adjust this section of the manual to best suit their needs.

Care should be taken when screening the students to assure that all will have sufficient basic laboratory skills to carry out the steps prior to the analytical techniques. If the individuals do not have these basic skills, the task of teaching these analytical methods becomes exceedingly difficult and the time lengthened to an extreme. If sufficient numbers are found not to possess these basic skills, as the instructor, you should consider how it would be best for these persons to attain these skills before they go on.

The outlines are found in the student's manual. Before attempting to use these outlines, you should read each of them yourself and if time permits, use them in a laboratory. All steps need not be carried out by a student in your course. For example, if you prepare standards and reagents ahead of time, this will considerably shorten the time. The number of instruments available for student use will dictate how you will present the course. Demonstrations as opposed to actual student use should be avoided if at all possible as this lessens the students chances of learning how to use the instrument himself.

If sufficient intructors are available, two laboratory sessions can be carried out simultaneously. Thus, only half the class will be involved with a particular piece of equipment. When each group has finished, they can switch and do the other half. This will reduce the number of pieces of equipment necessary.

The cover sheets included before each instructional unit will give the instructor an example of a lecture format outline for the presentation of the unit. The instructor should not consider this as the only method for presentation available. The students could also be broken down into small groups and asked to discuss amoung themselves different sections of the outline and prepare a summary of their discussion for presentation to the class. This is another way of obtaining student participation in the dissemination of the information.

The cover sheets as presented here are primarily designed to assure that all important points are covered by the instructor.

INSTRUCTOR'S LESSON PLAN

Title of Course: Methods for the Determination of Chemical Contaminants in Drinking Water

Unit Title: Sampling

Purpose:
To familiarize the trainee with the approved methods for obtaining representative drinking water samples and to determine sample worthiness for analysis utilizing a system of sample control.

Objective(s):
The trainee will be able to prepare containers for sampling, sample representatively, transport and store samples properly, survey sampling efforts with respect to frequency and control samples and record data properly.

Conditions:

From recall; after a lecture/discussion and demonstration.

From performance; when provided with sampling equipment and containers.

Instructional Technique:

Lecture/discussions
Demonstration; sampling equipment & containers
Group participation
Summary/quiz

Performance Level:
Answers on exam at end of course must be accurate for 66% of the questions pertaining to sampling procedures.

Participant Material:
Note paper
Pen/pencil
Instructional unit

Instructor Material:
Slides
Blackboard
Sampling equipment
Sampling containers
Instructional unit
Federal Register

Unit Time: 60 minutes

Activities:

Introduction	5 minutes
Lecture	15 minutes
Demonstration	10 minutes
Participation	15 minutes
Summary & Questions	5 minutes
Quiz & Answers	10 minutes

References:

Methods of Chemical Analysis of Water & Wastes, 1974 EMSL, EPA, Cinti., OH.

Std. Methods for the Examination of Water and Wastewater 13th ed. 1971. APHA, Washington DC.

National Interim Primary Drinking Water Requlations, Part IV, Dec. 24, 1975.

INSTRUCTOR'S LESSON PLAN

Page 2 of 3

Title of Course: Methods for the Determination of Chemical Contaminants in Drinking Water

Unit Title: Sampling

Time	Lesson Unit Outline	Key Points/Cue Aids
00.00	I. Introduction Inform trainee that all labs may not have responsibility to sample. However, the lab and Certification Officer must know proper technique to be able to certify.	
00.05	II. Lecture A. Sample Containers 1. Types 2. Materials 3. Sizes 4. Number needed 5. Shipping containers (boxes) 6. Covers (caps) B. Preparation of Sample Container for Sampling 1. Cleaning 2. Preservative addition 3. Storage C. Transportation of Containers to Sampling Location 1. Shipping containers 2. Covers D. Sample Collection 1. Instruction sheet 2. Sample type 3. Filling 4. Preservative addition 5. Sampling tag	

INSTRUCTOR'S LESSON PLAN

Page 3 of 3

Title of Course: Methods for the Determination of Chemical Contaminants in Drinking Water

Unit Title: Sampling

Time	Lesson Unit Outline	Key Points/Cue Aids
	E. Sample Storage 1. Ice chests 2. Shipping 3. Insulation	
	F. Transportation - Shipping of Samples 1. Keep in dark 2. Temperature 3. Time limits 4. Chain of custody	
	G. Laboratory Storage of Samples 1. Log book 2. Custody room 3. Access 4. Temperature	
	H. Lab Analysis Report Form Resample Requirements	
00.20	II. Demonstration	
00.30	III. Participation	
00.45	IV. Summary and Questions	
00.50	V. Quiz and Answers	
00.60	VI. Closing	

INSTRUCTOR'S LESSON PLAN

Page 1 of 2

Title of Course: Methods for the Determination of Chemical Contaminants in Drinking Water

Unit Title: Statistics: Accuracy-Precision-Error

Purpose:
To acquaint the trainee with the basic concept behind quality control.

Objective(s):
The trainee will use this information to better understand the requirements for Quality Control that the certification criteria has set down for laboratories doing analysis for compliance with the Safe Drinking Water Regulations.

Conditions:
The trainee should be able to comprehend meaning of the various terms used in the Quality Control section.

Instructional Technique:
Lecture/discussion - working examples

Performance Level:
The correct response to questions concerning Quality Control on a test.

Participant Material:
Note paper & pencil
Instructional material

Instructor Material:
2 x 2 slides
Diagrams
Example Problems

Unit Time: 75 minutes

Activities:

Introduction	5 minutes
Statistics	20 minutes
Accuracy & Precision	30 minutes
Example Calculations	15 minutes
Summary	5 minutes

References:

Instructional Outlines
Others as listed in outlines

INSTRUCTOR'S LESSON PLAN

Page 2 of 2

Title of Course: Methods for the Determination of Chemical Contaminants in Drinking Water

Unit Title: Statistics: Accuracy-Precision-Error

Time	Lesson Unit Outline	Key Points/Cue Aids
00.00	I. Introduction	
	Why statistics is important	
	Introduction to topic of Quality Control	
00.05	II. Statistics	
	Frequency	
	Control Tendency	
	Dispersion	
	Distribution Curves	
00.25	III. Accuracy-Precision-Error	
	Determination of Error and Accuracy	
	Determinate Error	
	Error and Precision	
	IV. Example Calculations	
	Example Calculations	
	Designed to illustrate above topics	
01.10	V. Summary	
01.15	VI. Closing	

INSTRUCTOR'S LESSON PLAN

Page 1 of 2

Title of Course: Methods for the Determination of Chemical Contaminants in Drinking Water

Unit Title: Quality Control

Purpose:
To acquaint the trainee with the information necessary to judge the quality control effort of a laboratory.

Objective(s):
In order to be able to judge the quality control effort the Certification Officer must know what is required and what would be acceptable by the Criteria and Procedures document.

Conditions:

Have the trainees evaluate materials presented to them as typifying a complete set of data for quality control.

Instructional Technique:

Lecture
Discussion
Lab Evaluation

Performance Level:
Should be able to respond correctly to questions concerning quality control on a test.

Participant Material:
Criteria on Quality Control

Paper and Pencil

Instructor Material:
Complete Document
Set of Example Data

Unit Time: 75 minutes

Activities:

Introduction
Quality Control Data:
  A. Mandatory
  B. Guideline
Summary

References:

Criteria and Procedures for Certification
Analytical Quality Control - EPA

INSTRUCTOR'S LESSON PLAN

Page 2 of 2

Title of Course: Methods for the Determination of Chemical Contaminants in Drinking Water

Unit Title: Quality Control

Time	Lesson Unit Outline	Key Points/Cue Aids
00.00	I. Introduction	
	A. Importance of Quality Control	
	B. Difference between	
	Mandatory Guideline	
	C. Rationale of Quality Control Section	
00.10	II. Quality Control Data	
	A. Mandatory	
	Inorganics AA Wet For large and small labs	
	Organics GC For large and small labs	
	B. Guidelines	
	Inorganics AA Wet For large and small labs	
	Organics	
	Radiological	
00.50	III. Summary and Questions	
00.75	IV. Closing	

INSTRUCTOR'S LESSON PLAN

Page 1 of 2

Title of Course: Methods for the Determination of Chemical Contaminants in Drinking Water

Unit Title: Laboratory Safety Practices

Purpose:
The purpose of this unit is to assure that the Certification Officer is aware of good safety practices. Although the survey will not include a specific check of laboratory safety equipment, the Certification Officer should know what equipment is necessary.

Objective(s):
The trainee will be able to advise on specific safety problems, point out deficient areas, and make recommendations for improvement of existing or beginning safety programs.

Conditions:
The trainee, after a discussion of accepted safety procedures, will inspect existing laboratory facilities for safety deficiencies. The trainee will also be tested by recall to check retention of facts.

Instructional Technique:

Lecture-Discussion
The instructor should point out areas in laboratories where hazards exist and the equipment recommended to combat these hazards. The students should be encouraged to discuss their experiences.

Performance Level:
The trainee should answer correctly the questions on a written examination.

Participant Material:

Paper and Pencil
Instruction Unit

Instructor Material:

Instructional Unit
2 x 2 or overheads

Unit Time: 60 minutes

Activities:

Introduction	15 minutes
Safety	30 minutes
Summary	15 minutes

References:

Guide for Safety in the Chemical Laboratory, the General Safety Committee of the Manufacturing Chemists Association, Inc. Van Nostrand, New York (1954).

INSTRUCTOR'S LESSON PLAN

Page 2 of 2

Title of Course: Methods for the Determination of Chemical Contaminants in Drinking Water

Unit Title: Laboratory Safety Practices

Time	Lesson Unit Outline	Key Points/Cue Aids
00.00 min.	I. Introduction Point out how safe techniques also promote accuracy in chemical techniques. Point out that everyone in a lab accumulates bad habits, or short-cuts, which can be dangerous.	
00.15 min	II. Safety A. General Practices - Use of chemicals - Use of glassware - Proper facilities - Needs: Fire extinguishers Eye washes Fire blinkers First aid kits Pipet bulbs Safety glasses B. Instrumental Safety - Use of gases - Use of high pressure tanks - Use of needles - Use of flames - Electrical hazards C. Other Subjects	
00.45 min.	III. Summary Re-emphasize that the person protected by good safety practices is the person the instructor is teaching.	
00.60 min.	IV. Closing	

INSTRUCTOR'S LESSON PLAN

Title of Course: Methods for the Determination of Chemical Contaminants in Drinking Water

Unit Title: Determination of Silver

Purpose: To acquaint the trainee with the approved methodology for the determination of silver in Drinking Water.	**Objective(s):** The trainee will be made aware of what methods are approved and should know how to carry out the procedure/s.
Conditions: Given the procedure and all necessary equipment and reagents the trainee must correctly analyze an unknown standard sample within the appropriate accuracy and precision of the method.	**Instructional Technique:** Lecture/Laboratory

Performance Level: The trainee should be able to answer the questions on a test concerning this method with 66% accuracy and be able to correctly analyze an unknown standard sample.	**Participant Material:** Instructional material Atomic Absorption Inst. and appropriate reagents and equipment.	**Instructor Material:** Instructional Outline Chalkboard Slides

Unit Time: Lecture: 45 minutes Laboratory: 120 minutes **Activities:** I. Introduction II. Analytical Methodology III. Summary & Questions	**References:** Methods for Cehmical Analysis of Water and Wastes, Technology Transfer, EPA, Cinti., OH, 1974, pg. 146. Standard Methods for the Examination of Water and Wastewater. 13th ed. APHA, 1971, pg. 210-215

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INSTRUCTOR'S LESSON PLAN

Page 2 of 2

Title of Course: Methods for the Determination of Chemical Contaminants in Drinking Water

Unit Title: Determination of Silver

Time	Lesson Unit Outline	Key Points/Cue Aids
00.00	I. Introduction Federal Register Listing of Methods Alternate Test Procedures-Approved MCL for Silver	
00.10	II. Approved Methodology A. Flame Method 1. Preservation of Handling 2. Pretreatment of Sample 3. Aspiration 4. Interferences 5. Quality Control	
00.35	III. Summary and Questions	
00.45	IV. Closing	

INSTRUCTOR'S LESSON PLAN

Page 1 of 2

Title of Course: Methods for the Determination of Chemical Contaminants in Drinking Water

Unit Title: Determination of Cadmium, Chromium and Lead (by Extraction)

Purpose:

To acquaint the trainee with the approved methodology for the determination of Cadmium, Chromium and Lead by extraction from drinking water.

Objective(s):

The trainee will be made aware of the approved methods and should know how to carry out the procedure/s.

Conditions:

Given the written procedure and all necessary equipment and reagents, the trainee must correctly analyze an unknown standard sample within the appropriate accuracy and precision of the method.

Instructional Technique:

Lecture/Laboratory

Performance Level:

The trainee should be able to answer the questions on a test concerning this method with 66% accuracy and be able to correctly analyze an unknown standard sample

Participant Material:

Instructional materials
Analytical Instrument,
Equipment and Reagents

Instructor Material:

Instructional outlines
Chalkboard
Slides

Unit Time: Lecture: 60 minutes
Laboratory: 150 minutes

Activities:

I. Introduction
II. Analytical Methodology
III. Summary and Questions

References:

Methods for Chemical Analysis of Water and Wastes, EPA, Technology Transfer, Cinti., OH., 1974.

Std. Methods for the Examination of Water and Wastewater, APHA, Washington, DC, 1971.

INSTRUCTOR'S LESSON PLAN

Page 2 of 2

Title of Course:	Methods for the Determination of Chemical Contaminants in Drinking Water
Unit Title:	Determination of Cadmium, Chromium and Lead (by Extraction)

Time	Lesson Unit Outline	Key Points/Cue Aids
00.00	I. Introduction	
	Federal Register Listing of Method Alternate Test Procedures - Approved MCL for Cd, Cr, Pb Choice of 13th or 14th ed. Std. Methods Agreement or Disagreement with EPA Methods Manual	
00.05	II. Approved Methodology	
	A. Chelation and Extraction	
	1. APDC or PDCA 2. Pretreatment of Sample 3. Instrumentation 4. Interferences 5. Quality Control	
00.50	III. Summary and Questions	
00.60	IV. Closing	

INSTRUCTOR'S LESSON PLAN

Title of Course: Methods for the Determination of Chemical Contaminants in Drinking Water

Unit Title: Determination of Mercury (Manual Cold Vapor Technique)

Purpose:

To acquaint the trainee with the approved methodology for the determination of mercury in drinking water.

Objective(s):

The trainee will be made aware of the approved method/s and should know how to perform this procedure.

Conditions:

Given the written procedure and all necessary equipment and reagents the trainee must correctly analyze an unknown standard sample within the appropriate accuracy and precision of the method.

Instructional Technique:

Lecture/Laboratory

Performance Level:

The trainee should be able to answer the questions on a test that concerns this method with 66% accuracy and be able to correctly analyze an unknown standard sample.

Participant Material:

Instructional Materials
Analytical Instrument
Equipment and Reagents

Instructor Material:

Instructional Outline
Chalkboard
Slides

Unit Time: Lecture: 60 minutes
Laboratory: 150 minutes

Activities:

I. Introduction
II. Analytical Methodology
III. Summary and Questions.

References:

Methods for Chemical Analysis of Water and Wastes, EPA, Technology Transfer, Cinti., OH. 1974, pg. 118-126.

INSTRUCTOR'S LESSON PLAN

Page 2 of 2

Title of Course: Methods for the Determination of Chemical Contaminants in Drinking Water

Unit Title: Determination of Mercury (Manual Cold Vapor Technique)

Time	Lesson Unit Outline	Key Points/Cue Aids
00.00	I. Introduction	
	Federal Register Listing of Method Alternate Test Procedures - Approved MCL for Hg Equipment Necessary Conventional AA Specific Mercury Analyzer	
00.15	II. Approved Methodology	
	A. Manual Cold Vapor Technique	
	1. Sampling Techniques	
	2. Equipment Set-Up a. Closed or Open System b. Traps c. Needs	Slides showing Instruments and arrangements
	3. Chemical Procedure 4. Interferences 5. Quality Control	
00.50	III. Summary and Questions	
00.60	IV. Closing	

INSTRUCTOR'S LESSON PLAN

Page 1 of 2

Title of Course: Methods for the Determination of Chemical Contaminants in Drinking Water

Unit Title: Determination of Nitrate

Purpose:
To acquaint the trainee with the approved methodology for the determination of Nitrate in drinking water.

Objective(s):
The trainee will be made aware of the approved methods and should know how to perform the procedures.

Conditions:
Given the written procedures and all necessary equipment and reagents the trainee must correctly analyze an unknown standard sample within the appropriate accuracy and precision of one of the methods.

Instructional Technique:
Lecture - Cover all approved procedures
Laboratory - The instructor should choose one method to be done by the trainee.

Performance Level:
The trainee should be able to answer the questions on a test that concern all methods with 66% accuracy and be able to correctly analyze an unknown standard sample by one method.

Participant Material:
Instructional Materials
Analytical Equipment and Reagents

Instructor Material:
Instructional Outlines
Chalkboard
Slides

Unit Time: Lecture- 75 minutes
Laboratory - 150 minutes

Activities:

I. Introduction
II. Analytical Methodology
III. Summary and Questions

References:

Methods for Chemical Analysis of Water and Wastes, EPA, Technology Transfer, Cinti., OH. 1974, pp 201-206.

Standard Methods for the Examination of Water and Wastes, 13th ed. 1971, APHA, Washington, DC pp 461-464.

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INSTRUCTOR'S LESSON PLAN

Title of Course: Methods for the Determination of Chemical Contaminants in Drinking Water

Unit Title: Determination of Nitrate

Time	Lesson Unit Outline	Key Points/Cue Aids
00.00	I. Introduction	
	Federal Register Listing of Methods Alternate Test Procedures - Approved MCL for Nitrate	
00.10	II. Approved Methodology	
	A. Brucine Procedure	
	1. Procedure 2. Interferences 3. Equipment needed 4. Quality Control	
00.35	B. Cadmium Reduction	
	1. Procedure 2. Interferences 3. Equipment Needed 4. Quality Control	
00.60	III. Summary and Questions	
00.75	IV. Closing	

INSTRUCTOR'S LESSON PLAN

Title of Course: Methods for the Determination of Chemical Contaminants in Drinking Water

Unit Title: Determination of Fluoride

Purpose:

To acquaint the trainee with the need to analyze for fluoride and to have the trainee know how to perform the analysis.

Objective(s):

The trainees will use this information to analyze drinking water samples in their laboratories to comply with the monitoring and analysis section of the Safe Drinking Water Act.

Conditions:

The trainee should be able to correctly analyze an unknown standard in the laboratory.

Instructional Technique:

Lecture/Laboratory

Performance Level:

The trainee should be able to answer the questions on a test that concerns this method with 66% accuracy and if actual laboratory work is done, correctly analyze an unknown standard sample within acceptable accuracy and precision data.

Participant Material:

Lecture - Participant Manual
Paper & Pencil
Laboratory - Equipment necessary to perform the analysis
Several Standard Samples

Instructor Material:

2 x 2 Slides
Diagrams
Chalkboard

Unit Time: 60 minutes

Activities:

I. Introduction 15 minutes
  A. Which Methods are Acceptable
  B. Advantages & Disadvantages of Each
II. Methodology 40 minutes
  A. SPADNS & Distillation
  B. Electrode
  C. Any Alternative Methods
III. Summary 5 minutes

References:

Methods for Chemical Analysis of Water and Waste EPA, Technology Transfer, Cinti., OH., pp 59-60 and 65-67.

Standard Methods for the Examination of Water & Wastes, 14th ed., pp 389-394.

INSTRUCTOR'S LESSON PLAN

Title of Course: Methods for the Determination of Chemical Contaminants in Drinking Water

Unit Title: Determinationf of Fluoride

Time	Lesson Unit Outline	Key Points/Cue Aids
00.00	I. Introduction	
	A. MCL and Temperature Dependence	
	B. Which Methods are Acceptable	
	1. SPADNS with Distillation	
	2. Electrode	
	3. Methods Alternatively Approved	
	C. Advantages of Each	
00.15	II. Methodology	
	A. SPADNS	
	1. Interferences	
	2. Distillation	
	3. Colorimetric Test	
	B. Electrode	
	1. Interferences	
	2. Use of Buffer	
	3. Procedure	
	C. Any Alternate Methods	
00.55	III. Summary	
	A. Importance of Determination	
	B. Acceptable Methods	
	C. MCL and Temperature Dependence	
00.60	IV. Closing	

INSTRUCTOR'S LESSON PLAN

Page 1 of 2

Title of Course: Methods for the Determination of Chemical Contaminants in Drinking Water

Unit Title: Determination of Barium

Purpose: To acquaint the trainee with the approved methodology for the determination of Barium in drinking water.	**Objective(s):** The trainee will be made aware of the approved methods and should know how to perform the analysis.
Conditions: Given the procedure and all necessary equipment and reagents, the trainess must correctly analyze an unknown standard sample within the appropriate accuracy and precision of the method.	**Instructional Technique:** Lecture/Laboratory

Performance Level: The trainee should be able to answer the questions on a test concerning this method with 66% accuracy and be able to correctly analyze an unknown standard sample.	**Participant Material:** Instructional materials Analytical instrument, equipment and reagents	**Instructor Material:** Instructional Outline Chalkboard Slides

Unit Time: Lecture: 45 minutes
Laboratory: 60 minutes

Activities:

I. Introduction
II. Analytical Method
III. Summary and Questions

References:

Standard Methods for the Examination of Water and Wastewater, 13th ed., 1971, APHA, Washington, DC, pgs. 210-215

Methods for Chemical Analysis of Water and Wastes, 1974, EPA, Cinti., OH, pgs. 97-98

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INSTRUCTOR'S LESSON PLAN

Title of Course: Methods for the Determination of Chemical Contaminants in Drinking Water

Unit Title: Determination of Barium

Time	Lesson Unit Outline	Key Points/Cue Aids
00.00	I. Introduction Federal Register Listing of Methods Alternate Test Procedures - Approved MCL for Ba	
00.10	II. Approved Methodology A. Flame Method 1. Preservation and Handling 2. Pretreatment of Sample 3. Aspiration 4. Interferences 5. Quality Control	
00.35	III. Summary and Questions	
00.45	IV. Closing	

INSTRUCTOR'S LESSON PLAN

Page 1 of 2

Title of Course: Methods for the Determination of Chemical Contaminants in Drinking Water

Unit Title: Determination of Residual Chlorine and Turbidity

Purpose:

To acquaint the trainee with the approved methodology for the determination of both free chlorine and turbidity.

Objective(s):

The trainee will be made aware of the approved methods and should know how to perform the methods, including the standardization of the equipment.

Conditions:

Given the procedure and all necessary equipment and reagents the trainee must correctly analyze an unknown standard sample within the appropriate accuracy and precision of the methods.

Instructional Technique:

Lecture/Laboratory

Performance Level:

The trainee should be able to answer the questions on a test concerning these methods with 66% accuracy and be able to correctly analyze an unknown standard sample.

Participant Material:

Instructional materials
Analytical equipment
and reagents

Instructor Material:

Instructional outlines
Chalkboard
Slides

Unit Time: Lecture: 45 minutes
Laboratory: 120 minutes

Activities:

I. Introduction

II. Analytical Methods

  A. Chlorine
  B. Turbidity

III. Summary and Questions

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References:

Chlorine:
Standard Methods for the Examination of Water and Wastewater, 13th ed. 1971, APHA, Washington, DC, pgs. 129-132.

Turbidity
Standard Methods for the Examination of Water and Wastewater, 13th ed. 1971, APHA, Washington, DC, pgs. 350-353.

Methods for the Chemical Analysis of Water and Wastes, 1974, EMSL, EPA, Cinti., OH, pgs 295-298.

INSTRUCTOR'S LESSON PLAN

Page 2 of 2

Title of Course: Methods for the Determination of Chemical Contaminants in Drinking Water

Unit Title: Determination of Residual Chlorine and Turbidity

Time	Lesson Unit Outline	Key Points/Cue Aids
00.00	I. Introduction	
	Federal/State Regulations for Chlorine and Turbidity Sampling for Chlorine and Turbidity Approved Equipment	
00.10	II. Methodology	
	A. Chlorine	
	DPD - Kits Standardization	
	B. Turbidity	
	Nephelometer Approved Type Standardization Formazine	
00.35	III. Summary and Questions	
00.45	IV. Closing	

INSTRUCTOR'S LESSON PLAN

Page 1 of 2

Title of Course: Methods for the Determination of Chemical Contaminants in Drinking Water

Unit Title: Determination of Chlorinated Hydrocarbon Pesticides

Purpose:

To acquaint the trainee with the approved methodology for the determination of Lindane, Endrin, Methoxychlor and Toxaphene.

Objective(s):

The trainee will be made aware of the approved method for extraction, clean-up and analysis of the chlorinated hydrocarbons listed in the Interim Primary Drinking Water Regulations.

Conditions:

Given the procedure and all necessary equipment and reagents the trainee must know the steps involved in carrying out the procedure.

Instructional Technique:

Lecture/Laboratory

Performance Level:

The trainee should be able to answer the questions on a test concerning this method with 66% accuracy.

Participant Material:

Instructional material
Analytical equipment and reagents

Instructor Material:

Instructional Outline
Chalkboard
Slides

Unit Time: Lecture: 60 minutes
Laboratory: Two (180 minute Labs)

Activities:

I. Introduction

II. Analytical Method

III. Summary and Questions

References:

Method for Organochlorine Pesticides in Industrial Effluents, EMSL, EPA, Cinti., OH., 45268, Nov. 28, 1973.

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INSTRUCTOR'S LESSON PLAN

Page 2 of 2

Title of Course: Methods for the Determination of Chemical Contaminants in Drinking Water

Unit Title: Determination of Chlorinated Hydrocarbon Pesticides

Time	Lesson Unit Outline	Key Points/Cue Aids
00.00	I. Introduction	
	Sampling Monitoring Frequencies MCL's	
00.15	II. Analytical Methodology	
	A. Extraction	
	B. Clean-up	
	1. Florisil Column Elution Rate Lauric Acid Value	
	2. Sodium Sulfate Column	
	C. Gas Chromatography	
	1. Equipment 2. Standardization 3. Interpretation of Data	
	D. Quality Control	
00.45	III. Summary and Questions	
00.60	IV. Closing	

INSTRUCTOR'S LESSON PLAN

Page 1 of 2

Title of Course: Methods for the Determination of Chemical Contaminants in Drinking Water

Unit Title: Determination of Chlorophenoxy Acid Herbicides

Purpose:
To acquaint the trainee with the approved methodology for the determination of 2.4-D and 2.4.5-TP Silver.

Objective(s):
The trainee will be made awere of the approved method for extracting, hydrolysis, esterification and analysis of the chlorophenoxy acid herbicides listed in the Interim Primary Drinking Water Regulations.

Conditions:

Given the procedure and all necessary equipment and reagents, the trainee must know the steps involved in carrying out the procedure.

Instructional Technique:

Lecture/Laboratory or Demonstration

Performance Level:

The trainee should be able to answer the questions on a test concerning this method with 66% accuracy.

Participant Material:

Instructional material
Analytical equipment and reagents

Instructor Material:

Instructional outline
Chalkboard
Slides

Unit Time: Lecture: 60 minutes
Laboratory: Two (180 minutes Labs)

Activities:

I. Introduction

II. Analytical Method

III. Summary and Questions

References:

Method for Chlorinated Phenoxy Acid Herbicides in Industrial Effluents, EMSL, EPA, Cinti., OH., 45268, Nov. 28, 1973.

INSTRUCTOR'S LESSON PLAN

Page 2 of 2

Title of Course: Methods for the Determination of Chemical Contaminants in Drinking Water

Unit Title: Determination of Chlorophenoxy Acid Herbicides

Time	Lesson Unit Outline	Key Points/Cue Aids
00.00	I. Introduction Sampling Monitoring Frequencies MCL's	
00.15	II. Analytical Methodology Sample Preparation Extraction Hydrolysis Esterification Gas Chromatography Equipment Standardization Interpretation of Data Quality Control	
00.45	III. Summary and Questions	
00.60	IV. Closing	

F. OPTIONAL UNIT

A PROTOTYPE FOR DEVELOPMENT OF ROUTINE OPERATIONAL PROCEDURES

for the

PREPARATION OF CALIBRATION GRAPHS

as applied in

WASTEWATER TREATMENT FACILITIES
and in the
MONITORING OF EFFLUENT WASTEWATERS

Developed by the

National Training and Operational Technology Center
Municipal Operations and Training Division
Office of Water Program Operations
U.S. Environmental Protection Agency

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EFFLUENT MONITORING PROCEDURE: Preparation of Calibration Graphs

This operational procedure was developed by:

NAME Charles R. Feldmann

ADDRESS EPA, OWPO, NTOTC, Cincinnati, Ohio 45268

POSITION Chemist-Instructor

EDUCATION AND TECHNICAL BACKGROUND

B.S. - Chemistry

M.S. - Chemistry

1-1/2 years Industrial Chemist

4 years additional Graduate School

4 years college Chemistry Instructor

1-1/2 years DHEW - Air Pollution Program, Chemist

10 years DI - EPA, Chemist-Instructor

EFFLUENT MONITORING PROCEDURE: Preparation of Calibration Graphs

1. Analysis Objectives:

The learner will prepare a calibration graph and will use it to determine the concentration of a chemical constituent in a sample of sewage effluent.

The word concentration means how much of the chemical constituent is present in a certain amount of sample; 1.0 milligram/liter is an example value of concentration.

2. Brief Description of Analysis:

In the field of water pollution analysis, calibration graphs are commonly used in two areas: absorbance and transmittance measurements. In the first case, energy is absorbed by some chemical constituent in a solution. In the second case, energy is transmitted by some chemical constituent in a solution. The amount of energy absorbed or transmitted can be related to the quantity of chemical constituent in a water sample by means of a calibration graph. Examples of absorbance measurements are colorimetric determinations, such as nitrate or phosphate using a spectrophotometer, and the determination of mercury or iron using atomic absorption. Examples of transmittance measurements are the determinations of sodium or potassium using flame photometry.

Two things must be done in order to prepare a calibration graph. A series of standards must be prepared. A standard is a solution which contains a known amount of the same chemical constituent which is being determined in the sample. Secondly, the absorbance or transmittance of these standards must be measured.

In order to actually determine how much of the chemical constituent is in the sample, the absorbance or transmittance of the sample must first be determined. The amount of chemical constituent is then read from the calibration graph.

For the sake of simplifying the instructions, absorbance values only will be used in the following procedure.

EFFLUENT MONITORING PROCEDURE: Preparation of Calibration Graphs

General Description of Equipment Used in the Process

A. Capital

None

B. Reusable

1. One ruler, 12 inches long
2. Pencil
3. Eraser

C. Consumable

1. Graph paper (one piece for each calibration graph). There are many kinds of graph paper. In ordinary water pollution analyses, a simple type of graph paper is used. Figure 1 is an example of the type of simple graph paper. The main feature of simple graph paper is that it is divided into a certain number of large squares of equal size. (For example, one inch might be the length of one side of the large squares). These large squares are subdivided into a certain number of smaller squares of equal size. (For example, a one inch square might be subdivided into one hundred small squares).

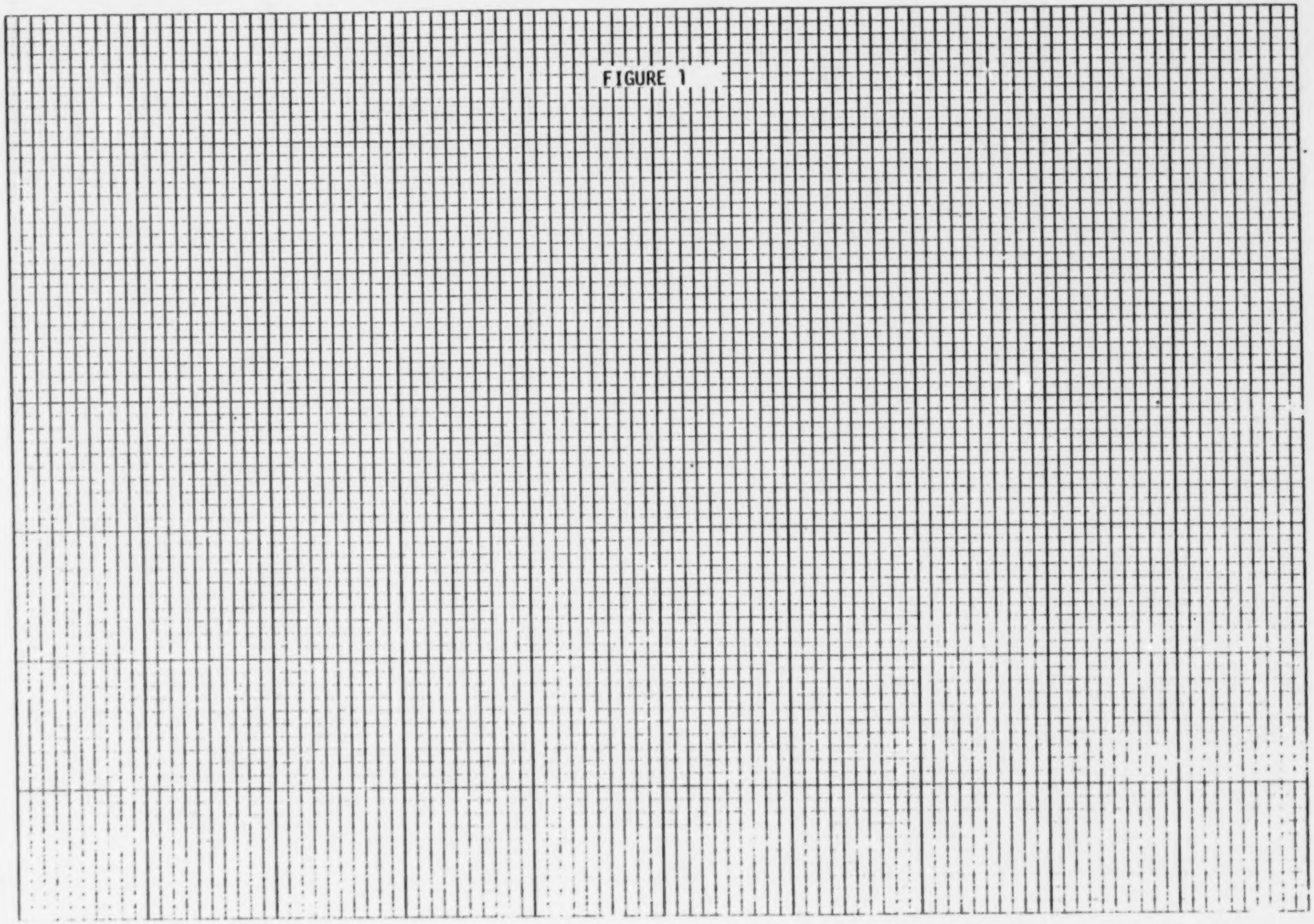
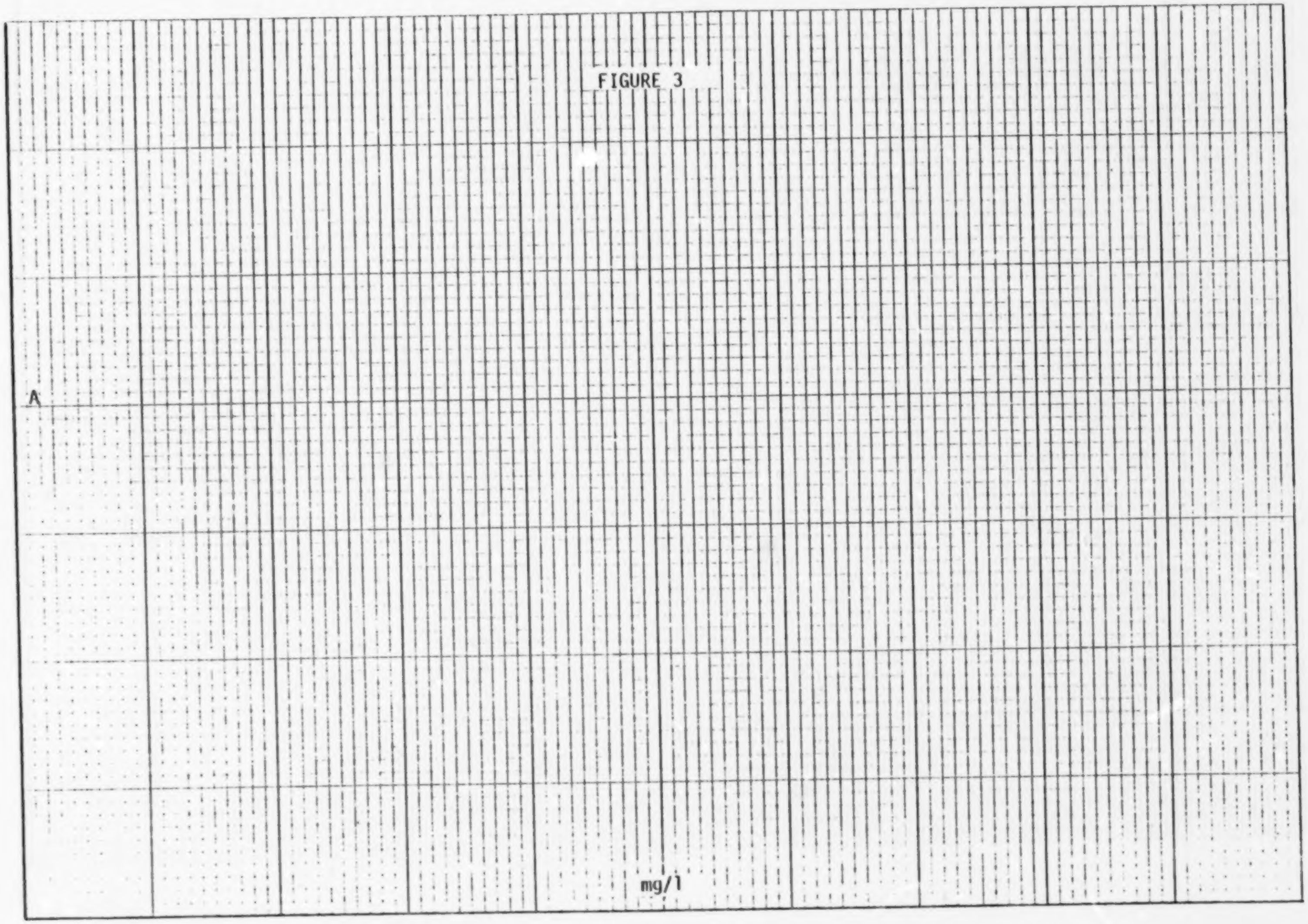


FIGURE 1

FIGURE 2

FIGURE 3



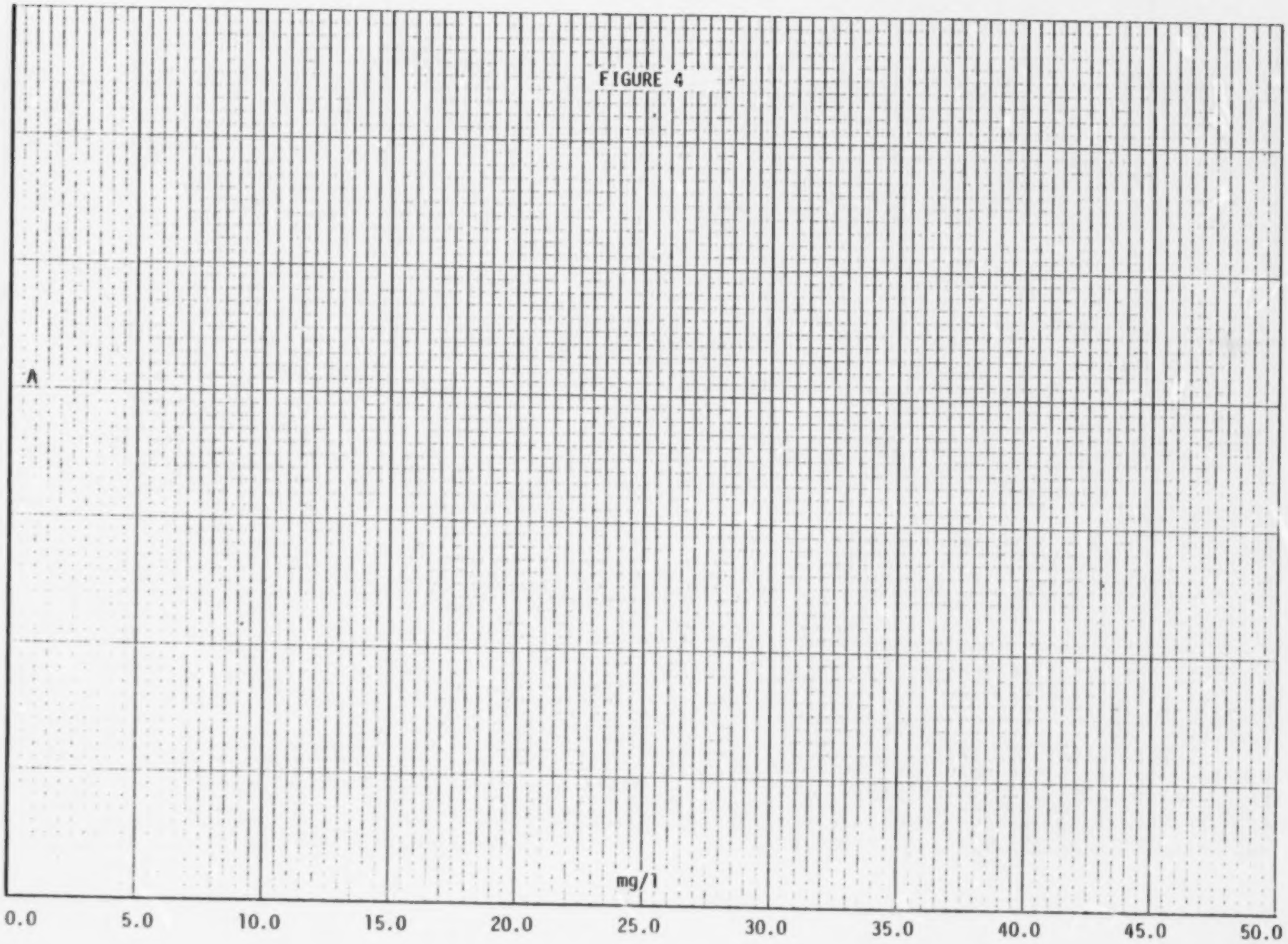


FIGURE 4

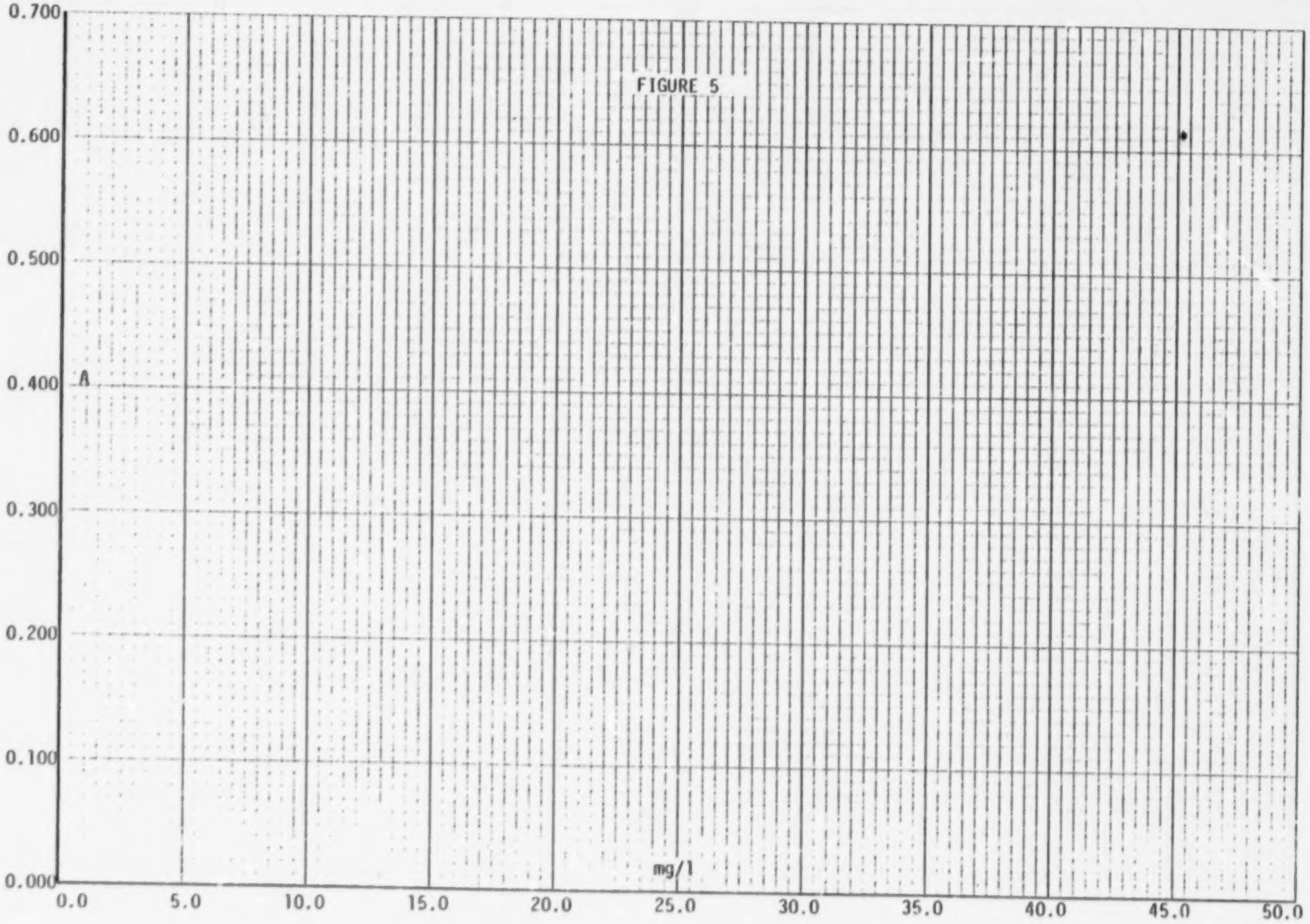

A
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0
50.0
mg/l

FIGURE 5

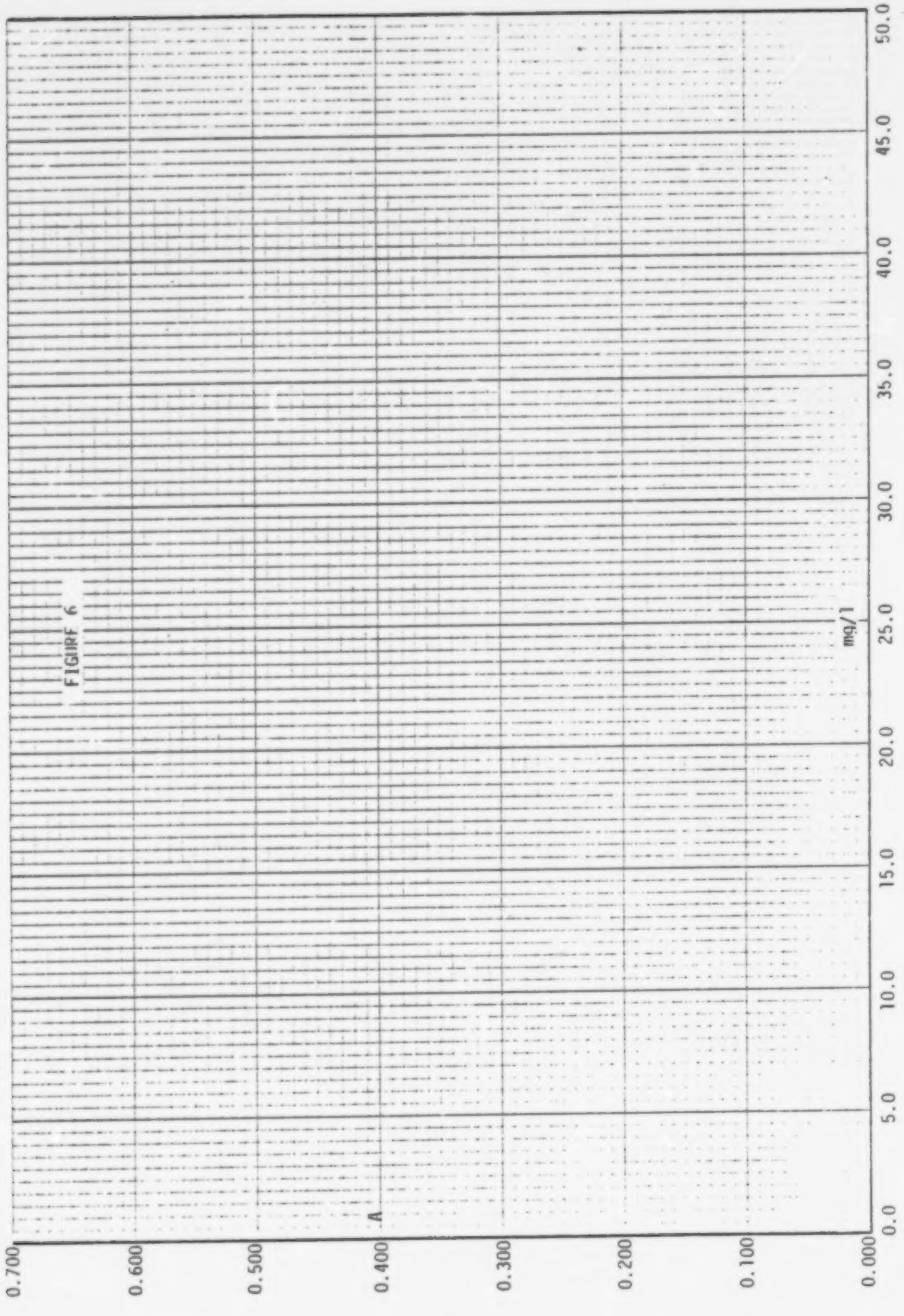
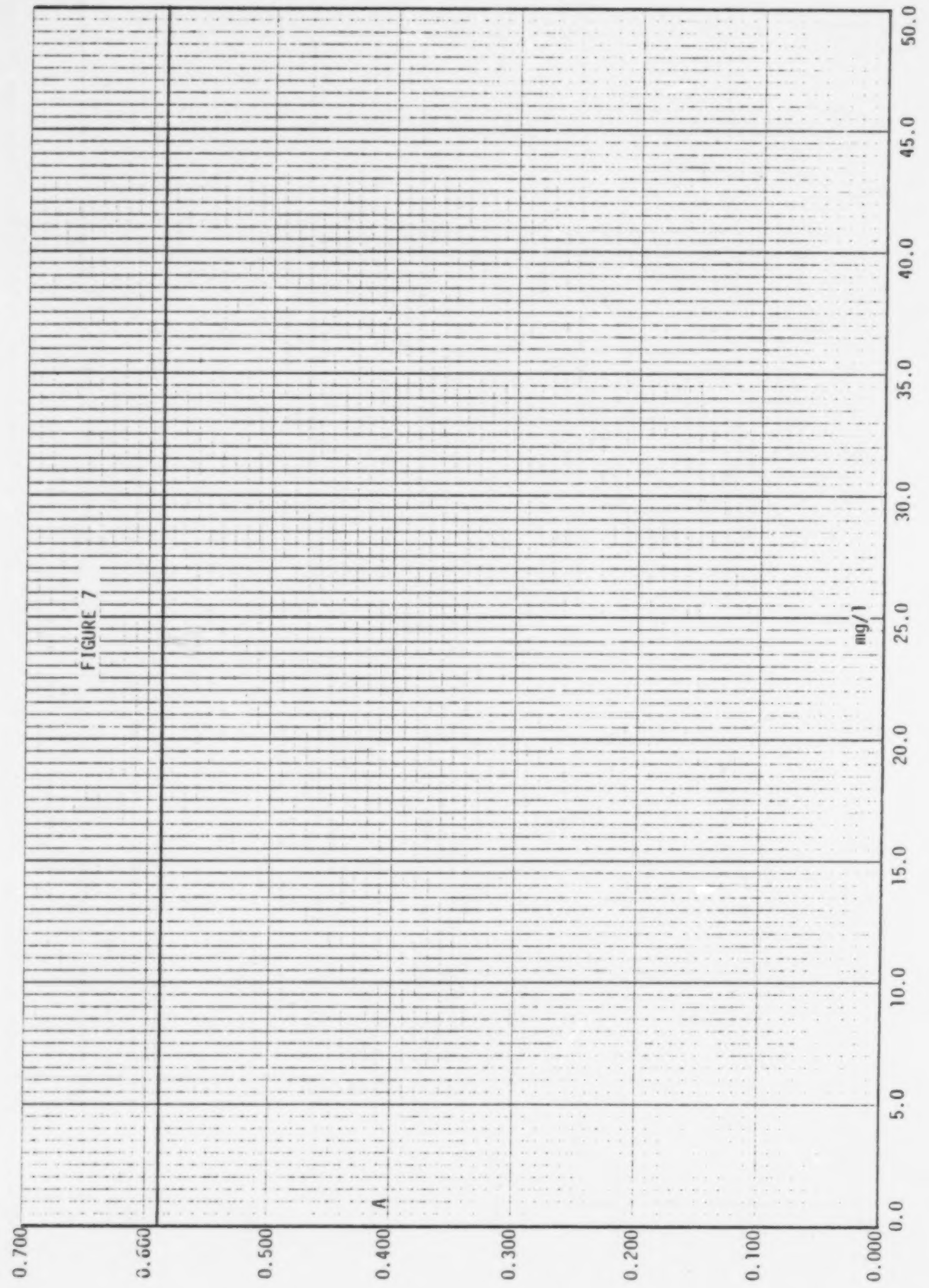


FIGURE 6

0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
A
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0
50.0
mg/l

FIGURE 7


0.700
0.600
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0.400
0.300
0.200
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0.000
A
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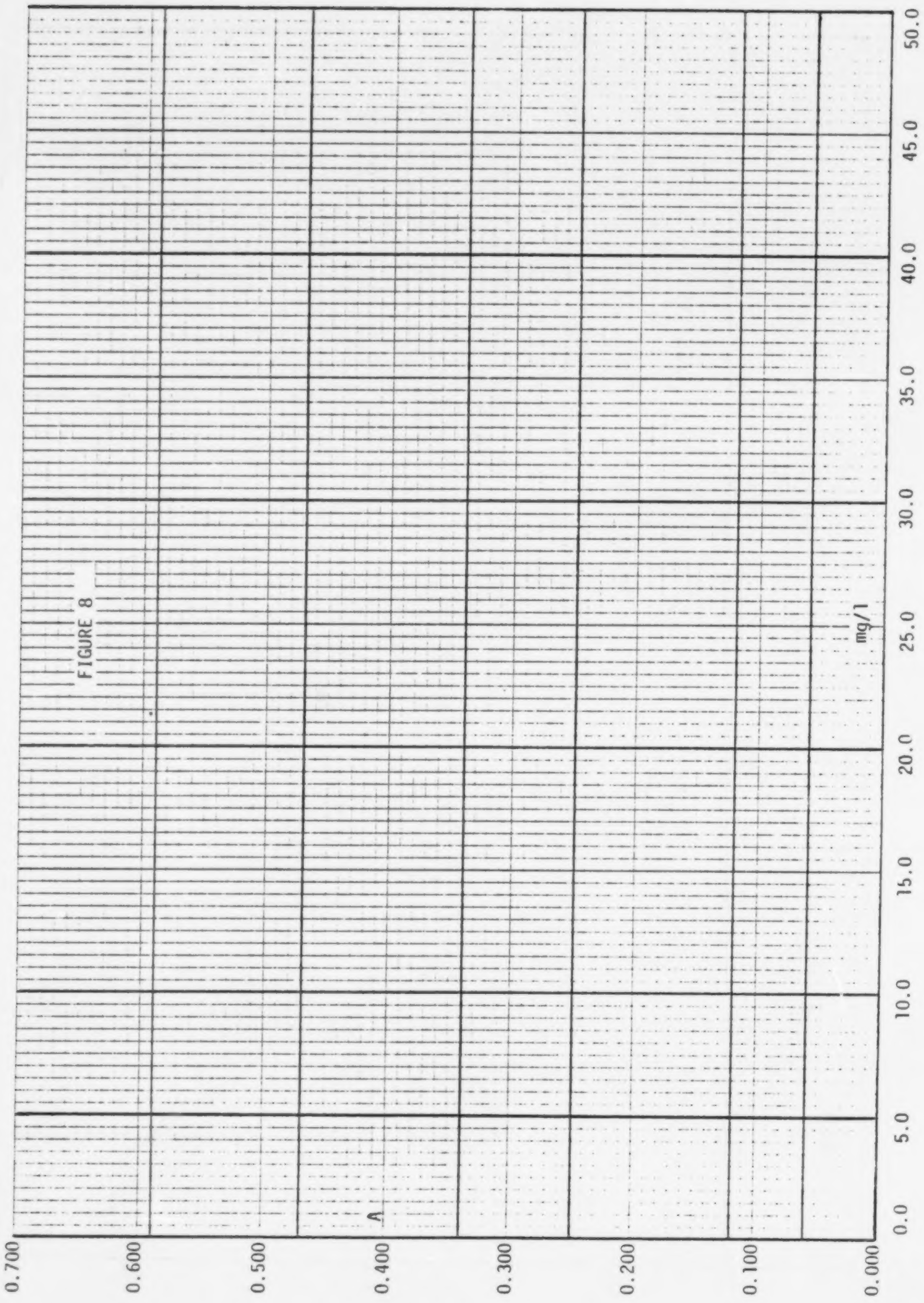
25.0
30.0
35.0
40.0
45.0
50.0
mg/l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5.0
10.0
15.0
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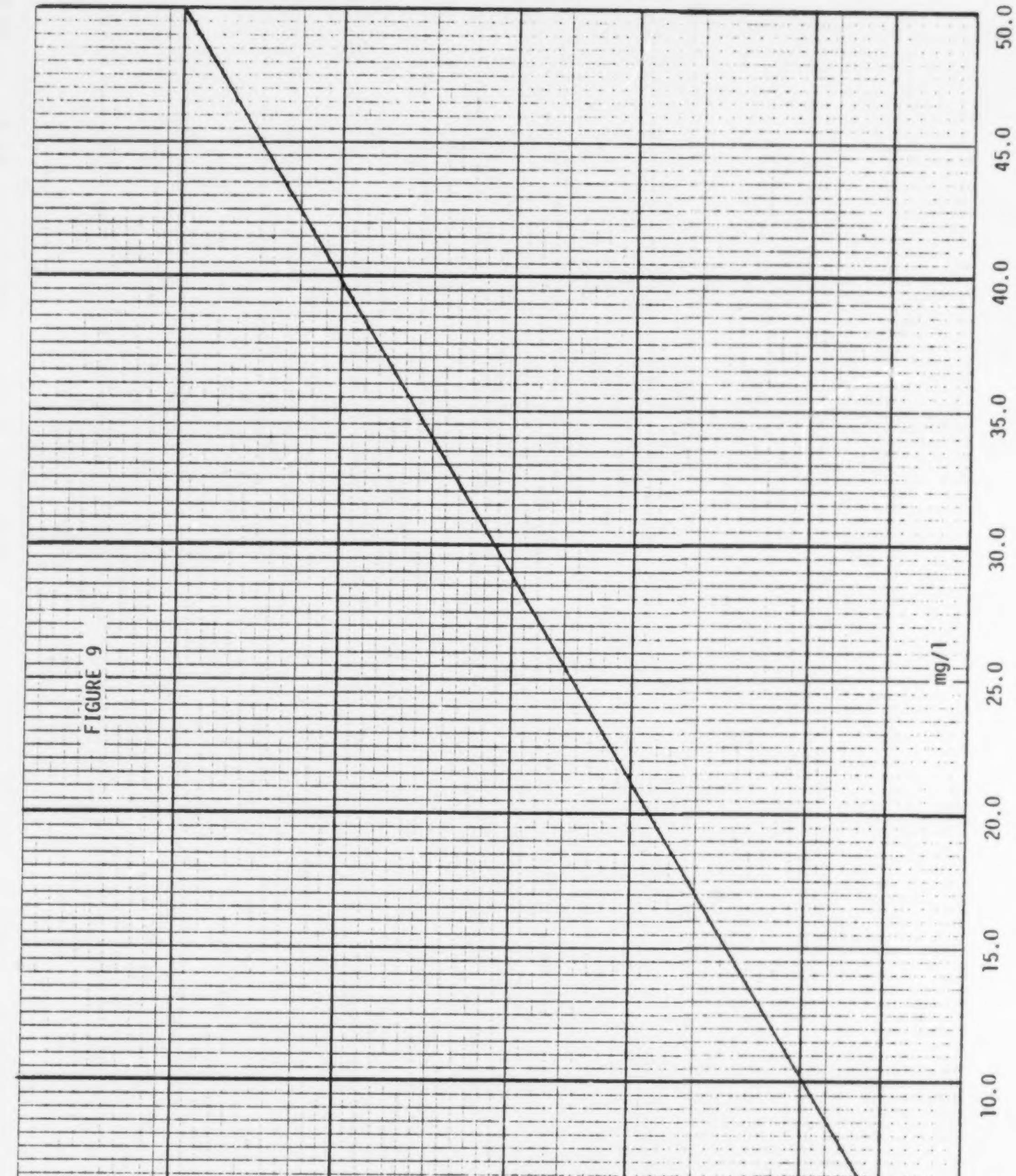
25.0
30.0
35.0
40.0
45.0
50.0
mg/l
A

FIGURE 8

FIGURE 9


A
0.000
0.100
0.200
0.300
0.400
0.500
0.600
0.700
mg/l
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0
50.0

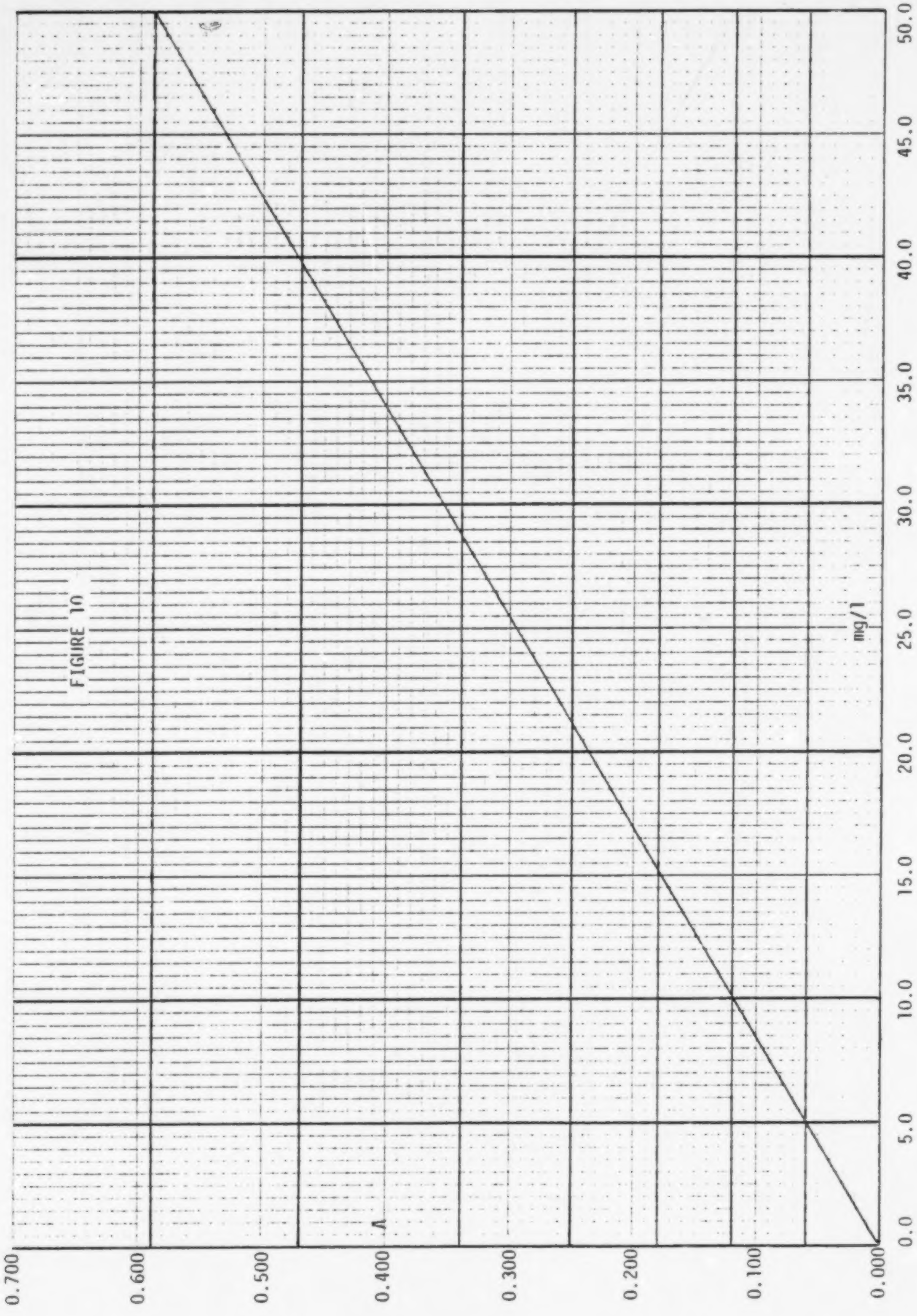


FIGURE 10

A
mg/l
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0
50.0

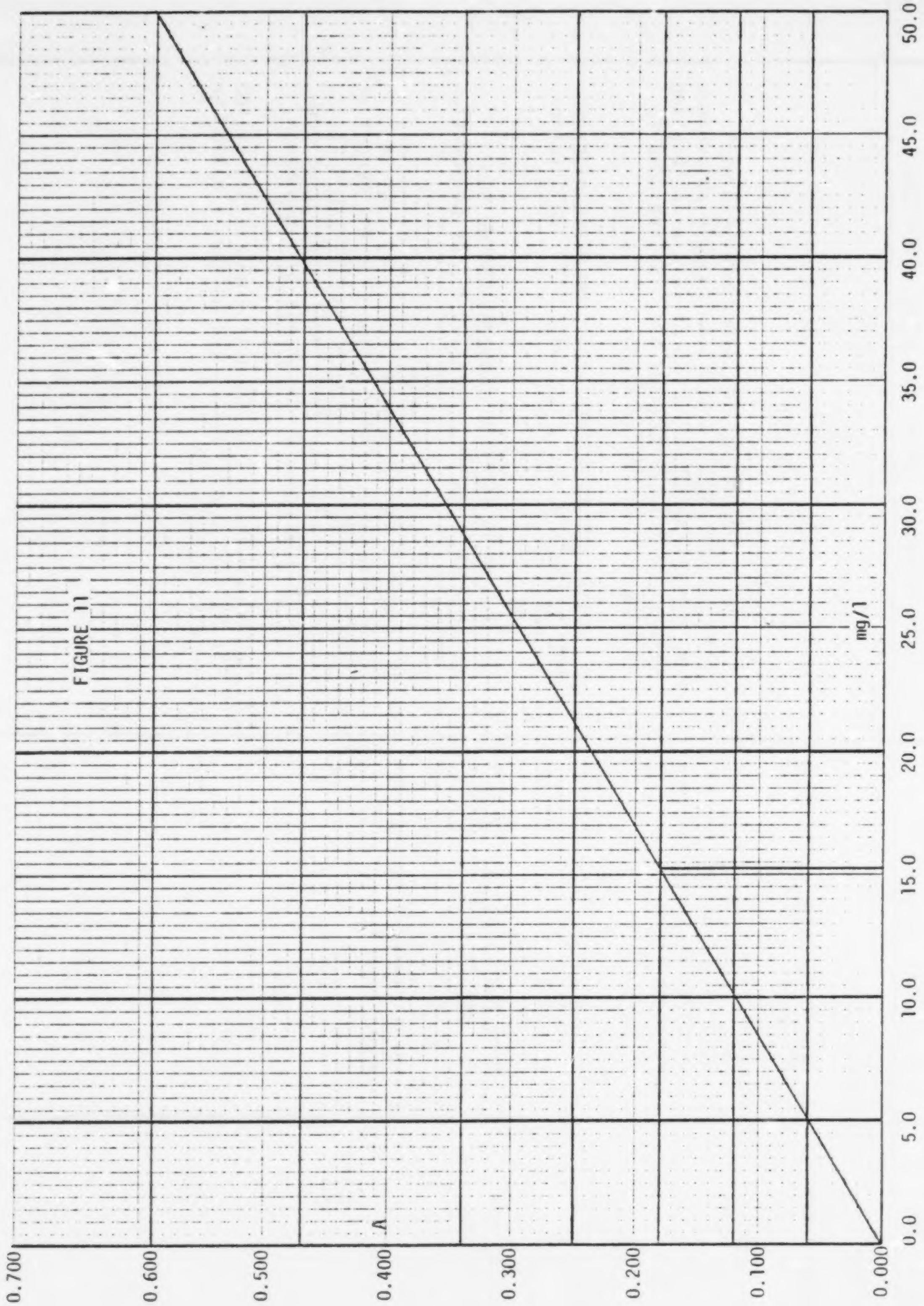


FIGURE 11

A
0.000
0.100
0.200
0.300
0.400
0.500
0.600
0.700
mg/l
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0
50.0

OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION/OPERATING GOALS/SPECIFICATIONS	TRAINING GUIDE NOTES
A. Graph Paper			
1. General comments	1. Remove the page containing figure 1.		
	2. Lay it on a desk or any other place where it will be convenient for you to write on it.	2a. For the remainder of this procedure, you will actually use figure 1 and some example absorbance and concentration values to prepare a calibration graph. Additional figures are also included to demonstrate the instructions.	
		2b. You will have to furnish your own piece of graph paper when you want to prepare other calibration graphs.	
2. Labeling the graph paper	1. Draw two lines on figure 1 so that it looks like figure 2.	1a. Use a pencil, since you may have to do some erasing during the preparation of the calibration graph.	
	2. Label figure 1 so that it looks like figure 3.	2a. mg/l stands for milligrams per liter. It is an expression of concentration. If the amount of chemical constituent present in the sample is extremely small, the label μg/l (micrograms per liter) might be used. A stands for absorbance.	
		2b. The mg/l line is a horizontal line. It is called the X axis, or abscissa. The A line is called the Y axis, or ordinate.	

OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION/OPERATING GOALS/SPECIFICATIONS	TRAINING GUIDE NOTES
A. Graph Paper (continued)	3. Examine the example absorbance and concentration values in the column at the right.	3a. mg/l — A 0.0 — 0.000 5.0 — 0.060 10.0 — 0.120 20.0 — 0.250 30.0 — 0.340 40.0 — 0.470 50.0 — 0.590 A of sample = 0.180	
		3b. It is data for a series of standards.	
		3c. Each pair of values (e.g. 5.0 and 0.060) represents a point on the graph.	
		3d. Later, you will complete the calibration graph by drawing a straight line through the seven points.	
	4. Note that the lowest mg/l value is 0.0 and the highest is 50.0.		
	5. Mark the mg/l axis on figure 1 so that it looks like figure 4.	5a. Note that the entire length of the mg/l axis was used. Always use as much of this line as is convenient. Do not, for example, use only one-half of the mg/l axis to mark off the values.	
		5b. Also note that each of the large squares is marked as a whole number of mg/l.	
		5c. Two of the smaller squares equal 1 mg/l.	

OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION/OPERATING GOALS/SPECIFICATIONS	TRAINING GUIDE NOTES
A. Graph Paper (continued)	6. Note that the lowest A value is 0.000 and the highest is 0.590.	6a. It is generally not considered good practice to have A values greater than 0.6 or 0.7.	
	7. Mark the A axis on figure 1 so that it looks like figure 5.	7a. Note that the entire length of the A axis was used. Always use as much of this line as convenient. Do not, for example, use only one-half of the A axis to mark off the values. 7b. Also note that each of the large squares is marked as a whole number of A units. 7c. One of the smaller squares equals 0.01 A units. 7d. If transmittance measurements were being made, the Y axis or ordinate, would be marked T. T axes are always marked from 0 (bottom of axis) to 100 (top of axis).	
3. Drawing the calibration graph	1. On figure 1 draw a vertical line from the 50.0 mg/l point of the mg/l axis to the top of the graph.	1a. Figure 1 should now look like figure 6.	
	2. On figure 1 draw a horizontal line from the 0.590 point of the A axis to the right side of the graph.	2a. Figure 1 should now look like figure 7. 2b. The intersection of these two lines is the point represented by a concentration of 50.0 mg/l and an absorbance of 0.590.	

OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION/OPERATING GOALS/SPECIFICATIONS	TRAINING GUIDE NOTES
A. Graph Paper (continued)	3. Using the same technique as in 1 and 2 above, locate the next five points on figure 1.	3a. The point located at 0.0 and 0.000 is at the intersection of the mg/l and A axes. 3b. Your graph should now look like figure 8. Some analyses may require more than five points.	
	4. Lay your ruler on figure 1.	4a. So one end of it lies at the 0.0 - 0.000 point, and at the 50.0 - 0.590 point.	
	5. Look along the edge of the ruler.	5a. The other five points (represented by the intersections of the horizontal and vertical lines do not all lie along the edge of the ruler.	
	6. Draw a line between the 0.0 - 0.000 and the 50.0 - 0.590 points.	6a. Note that some of the points lie slightly above the line, some lie slightly below the line, and some lie on the line. If one point is considerably off the line, some error in preparing the particular standard was probably made. 6b. This is the line of best fit for the seven points. Always draw the line of best fit when preparing calibration graphs. 6c. The calibration graph is now complete. 6d. Figure 1 should now look like figure 9. 6e. After you have prepared a few calibration graphs, you will find that you won't have to draw the horizontal and vertical lines to locate the points. You'll be able to move your pencil along the graph paper and put dots at the appropriate points. You'll then draw the line of best fit through them to the 0.0 - 0.000 point.	

OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION/OPERATING GOALS/SPECIFICATIONS	TRAINING GUIDE NOTES
B. Determining the Concentration of the Chemical Constituent in the Sample.	1. Locate 0.180 on the A axis.	1a. This was the absorbance of the sample.	
	2. Draw a horizontal line to the right side of the paper.	2a. It should now look like figure 10.	
	3. Locate the intersection of this horizontal line and the sloping calibration graph.		
	4. From this intersection, draw a vertical line down to the bottom of the paper.	4a. It should now look like figure 11.	
	5. Note that the vertical line crosses the mg/l axis at 15.3.	5a. Recall that on the mg/l axis, 2 of the small squares equal 1 mg/l. 5b 15.3 mg/l is therefore the concentration of the chemical constituent being measured in the sample.	
C. Sample Dilution	1. If it was necessary to dilute the sample, the value read from the mg/l axis must be multiplied by a dilution factor.	1a. The dilution may have been necessary so that the A value for the sample would not be greater than the A value obtained for the highest concentration standard; 0.590 in this set of example data. 1b. The dilution factor is the ml of sample taken for dilution, divided into the ml to which it was diluted; e.g., if 10.0 ml of the original sample were diluted to 1000 ml (as in a volumetric flask) the dilution factor would be 1000/10, or 100. 1c. In some determinations, you may prepare more than one dilution of the sample. Look at the mg/l axis of figure 1 and assume that three dilutions of the sample gave values of 2.2, 24.0, and 48.0 mg/l, before correcting for the dilution factor. It is common practice to use the 24.0 value, since it lies nearest the middle of the calibration graph.	

COURSE ASSESSMENT AND EVALUATION

INTRODUCTION

This concluding section contains five items related to assessment and evaluation:

1. Daily Participant Feedback Forms
2. Pre-and Post-Test Forms
3. Instructor Feedback Report Forms
4. Instructor Manual and Course Evaluation Forms
5. Six Month Follow-up Questionnaire. (See Participant's Handbook).

These instruments serve a variety of purposes. First, they will provide you with information you need for your purposes and effectiveness. Next, they will help future designers improve the quality of instruction. And finally, the instruments will enable the EPA to measure the extent to which these courses are meeting the perceived needs of participant groups.

There is an explanatory note attached to each of the forms except for Items 2 and 5. Regarding these a brief comment is in order. Since the Pre-Test was administered before the course, and discussed elsewhere in this manual, it is necessary only to include a copy of the test here. The Post-Test purpose is straight forward and obvious.

The Six Month Follow-up Questionnaire is explained in the Participant's Handbook. It is expected that you will explain these at the end of the course and encourage the students to return them to you.

DAILY PARTICIPANT FEEDBACK FORMS

Since the exact make-up of each days material is ultimately left to the Course Coordinator, the daily participant feed-back forms may have to be slightly rewritten. If a laboratory has been rescheduled or dropped from the Example Agendas, these feed-back forms will not be applicable. Therefore, these should be used as guides and rewritten by the Course Coordinator to reflect changes.

METHODS FOR THE DETERMINATION OF CHEMICAL CONTAMINANTS IN DRINKING WATER

Daily Participant Feed-Back Report

Name ________________________________

Date __________________

Day One

1. Were the course preliminaries (registration, welcome, statement of course objectives) handled clearly and adequately?

   a. Circle one:

	Low				High
	1	2	3	4	5

   b. Comments:

2. In your judgment, what, if anything, was missing from the topics included in today's program?

3. Identify any questions or needs you had today which went unanswered.

4. Which unit did you consider to be the most effective and useful?

5. Identify any unit which you believe should be reduced in depth of coverage, or even dropped.

6. Identify any unit which you believe should have been developed in greater detail.

7. Comments on quality of presentations. (Address your remarks to such factors as instructor knowledge of subject, relevance of coverage to course objectives, technical level of presentation, and effectiveness of student reference materials and visual aids.

METHODS FOR THE DETERMINATION OF CHEMICAL CONTAMINANTS IN DRINKING WATER

Daily Participant Feed-Back Report

Name ______________________________

Date ___________________

Day Two

1. In your judgment, what, if anything, was missing from the topics included in today's program?

2. Identify any questions or needs you had today which went unanswered.

3. Which unit did you consider to be the most effective and useful?

4. Identify any unit which you believe should be reduced in depth of coverage, or even dropped.

5. Identify any unit which you believe should have been developed in greater detail.

6. Comments on quality of presentations. (Address your remarks to such factors as instructor knowledge of subject, relevance of coverage to course objectives, technical level of presentation, and effectiveness of student reference materials and visual aids.)

7. Was the laboratory session helpful and at the right level? (Any suggestions concerning the laboratory session should be included here.)

METHODS FOR THE DETERMINATION OF CHEMICAL CONTAMINANTS IN DRINKING WATER

Daily Participant Feed-Back Report

Name ____________________________

Date __________________

Day Three

1. In your judgment, what, if anything, was missing from the topics included in today's program?

2. Identify any questions or needs you had today which went unanswered.

3. Which unit did you consider to be the most effective and useful?

4. Identify any unit which you believe should be reduced in depth of coverage, or even dropped.

5. Identify any unit which you believe should have been developed in greater detail.

6. Comments on quality of presentations. (Address your remarks to such factors as instructor knowledge of subject, relevance of coverage to course objectives, technical level of presentation, and effectiveness of student reference materials and visual aids.)

7. Was the laboratory session helpful and at the right level? (Any suggestions concerning the laboratory session should be included here.)

METHODS FOR THE DETERMINATION OF CHEMICAL CONTAMINANTS IN DRINKING WATER

Daily Participant Feed-Back Report Name ____________________

Date ______________

Day Four

1. In your judgment, what, if anything, was missing from the topics included in today's program?

2. Identify any questions or needs you had today which went unanswered.

3. Which unit did you consider to be the most effective and useful?

4. Identify any unit which you believe should be reduced in depth of coverage, or even dropped.

5. Identify any unit which you believe should have been developed in greater detail.

6. Comments on quality of presentations. (Address your remarks to such factors as instructor knowledge of subject, relevance of coverage to course objectives, technical level of presentation, and effectiveness of student reference materials and visual aids.)

7. Was the laboratory session helpful and at the right level? (Any suggestions concerning the laboratory session should be included here.)

METHODS FOR THE DETERMINATION OF CHEMICAL CONTAMINANTS IN DRINKING WATER

Daily Participant Feed-Back Report

Name ______________________________

Date ______________________

Day Five

1. In your judgment, what, if anything, was missing from the topics included in today's program?

2. Identify any questions or needs you had today which went unanswered.

3. Which unit did you consider to be the most effective and useful?

4. Identify any unit which you believe should be reduced in depth of coverage, or even dropped.

5. Identify any unit which you believe should have been developed in greater detail.

6. Comments on quality of presentations. (Address your remarks to such factors as instructor knowledge of subject, relevance of coverage to course objectives, technical level of presentation, and effectiveness of student reference materials and visual aids.)

7. Was the laboratory session helpful and at the right level? (Any suggestions concerning the laboratory session should be included here.)

Pre-Test

1. The analytical methods to be used in the analyses of Drinking Water Samples are set down in the

   a. Interim Primary Drinking Water Regulations
   b. Safe Drinking Water Act
   c. Clean Water Act

2. Organic samples are collected in containers.

   a. glass or plastic
   b. glass only
   c. plastic only

3. The maximum holding time recommended for metals is

   a. 14 days
   b. 180 days
   c. 30 days

4. A statistical measurement for precision is

   a. percent recovery
   b. central tendency
   c. standard deviation

5. Minimum quality control requires that daily checks of a standard curve be within of the original curve.

   a. ± 10%
   b. ± 5%
   c. ± 2%

6. Safety practices should be carried out

   a. at all times
   b. only when hazardous materials are being used
   c. only when the supervisors are watching

7. The required analytical method, published in the Interim Primary Regulations, for silver is

   a. dithizone
   b. silver diethyldithiocarbamate
   c. standard atomic absorption techniques

8. The MCL for silver was based on considerations.

   a. cost
   b. aesthetic
   c. health

9. The oxidant and fuel gases used when silver is determined are

   a. air-acetylene
   b. nitrous oxide-acetylene
   c. argon-hydrogen

10. In order to determine cadmium, chromium and lead at their MCL's, the sample needs to

   a. be solubilized —
   b. extracted and concentrated
   c. both

This item should be changed. A different procedure for these metals is now in the student training manual (april, 1980).

11. The oxidant and fuel gases used to determine cadmium, chromium and lead are

   a. air-acetylene
   b. nitrous oxide-acetylene
   c. argon-hydrogen

12. The extraction technique   See note for 10. above.

   a. necessitates doing each metal (cadmium, chromium, lead) separately
   b. allows all metals (cadmium, chromium, lead) to be done with one extraction
   c. need a preliminary colorimetric procedure.

13. The determination of mercury is carried out by

   a. normal atomic absorption techniques
   b. colorimetricly
   c. a flameless atomic absorption technique

14. The oxidant and fuel gases used to determine mercury

   a. are air-acetylene
   b. nitrous oxide-acetylene
   c. air only

15. The organic forms of mercury are   to convert to metallic form.

   a. difficult
   b. easy
   c. impossible

16. The oxidant and fuel gases used to determine arsenic and selenium are

   a. air-acetylene
   b. nitrous oxide-acetylene
   c. argon-hydrogen

17. Organic forms of arsenic are analyzed   by the gaseous hydroxide method.

   a. directly
   b. after an oxidation step
   c. colorimetricly

18. The zinc slurry provides in the gaseous hydride procedures for arsenic and selenium.

    a. for the reduction
    b. the hydrogen for the flame
    c. the hydrogen to form the hydride

19. Nitrate is determined in the cadmium reduction method.

    a. as nitrate
    b. as nitrite
    c. as cadmium

20. Nitrate samples for the reduction column should not be preserved with

    a. sulfuric acid
    b. refrigeration at 4°C
    c. mercuric chloride

21. The nitrate sample for the cadmium reduction method is filtered to remove turbidity which could

    a. react with the nitrate
    b. oxidize the nitrate to nitrite
    c. restrict flow through the column

22. The brucine test analyzes nitrate as

    a. nitrate
    b. nitrite
    c. brucine

23. One extremely important control in the brucine test is

    a. size of the particles
    b. concentration of nitrite
    c. temperature

24. The brucine-nitrate test is a test.

    a. colorimetric
    b. atomic abosrption
    c. titrametric

25. For drinking water samples must precede the SPADNS test.

    a. filtration
    b. use of the electrode
    c. distillation

26. Fluoride samples are preserved by the addition of

    a. nothing
    b. nitric acid
    c. mercuric chloride

27. The SPADNS method for fluoride is a   procedure.

    a. colorimetric
    b. atomic absorption
    c. titrametric

28. The distillation procedure works by

    a. distilling over the interferences and leaving the F^- behind
    b. distilling over the F^- and leaving the interferences behind
    c. forming a color with the interferences

29. A new batch of acid/water mix must be used

    a. with each sample
    b. after three samples
    c. when the solution turns brown

30. If the temperature is allowed to go beyond 180°C

    a. the fluoride is not distilled
    b. the iron carries over
    c. sulfate is carried over

31. For drinking water samples   must procede the electrode method.

    a. nothing
    b. distillation
    c. filtration

32. The electrode must be connected to   for the F^- determination.

    a. pH meter with expanded scales
    b. specific ion meter
    c. either of the above

33. The electrode itself and the   account for the small number of interferences.

    a. distillation
    b. the TISAB buffer
    c. the complexone

34. Barium is determined by

    a. colorimetry
    b. atomic absorption
    c. titrametry

35. The barium samples are preserved by adding

    a. nitric acid
    b. sulfuric acid
    c. mercuric chloride

36. In order to express the value of "total" barium, a   step must be performed.

a. filtration
b. weighing
c. solubilization or digestion

37. The approved method for residual chlorine determination for water supply samples is the

a. o-tolidine
b. phenol red
c. DPD

38. The kit form of the approved method

a. can be used
b. cannot be used
c. must be applied for under alternate test procedures

39. Chlorine samples

a. can be preserved overnight
b. can be held for 48 hours
c. cannot be preserved

40. The turbidity sample must be taken

a. in the plant
b. at an entry point to the distribution system
c. in the distribution system

41. The reason for the MCL on turbidity is because

a. it may interfere with disinfection
b. it makes water look bad
c. it makes water taste bad

42. Turbidity measurement must be carried out

a. a number of times based on population served
b. once a week
c. once a day

43. The Interim Primary Drinking Water Regulations

a. become effective in December of 1977
b. became effective in December of 1975
c. became effective in June of 1977

44. The Interim Primary Drinking Water Regulations include maximum contaminant levels (MCL's) as well as monitoring frequencies for

a. chemical, bacteriological, radiological contaminants
b. chemical, bacteriological contaminants
c. chemical contaminants

45. The maximum holding time for the chlorinated hydrocarbons samples is

    a. 14 days
    b. 7 days
    c. none

46. The pesticides which are to be monitored are

    a. endrin, aldrin, lindane, methoxychlor, toxaphene
    b. endrin, lindane, methoxychlor, aldrin
    c. toxaphene, methoxychlor, lindane, endrin

47. The pesticides are extracted from the sample using

    a. hexane
    b. petroleum ether-ethylether
    c. hexane-methylene chloride

48. The chlorphenoxy herbicides to be monitored for are

    a. 2,4, D; 2,4,5 TP; 2,4,5 T
    b. 2,4, D; 2,4,5 T
    c. 2,4, D; 2,4, 5 TP

49. The herbicides are extracted from the sample using

    a. hexane
    b. hexane-methylene chloride
    c. ethylether

50. The maximum holding time for herbicide samples is

    a. 14 days
    b. 7 days
    c. none

KEY FOR PRE-TEST

Regulations

1.a

Sampling

2.b
3.b

Statistics

4.c

Quality Control

5.a

Safety

6.a

Silver

7.c
8.c
9.b

Cadmium, Chromium, and Lead

⑩.c See page G.2.A-2.
11.a
⑫.b

Mercury

13.c
14.c
15.a

Arsenic and Selenium

16.c
17.b
18.c

Nitrate

19.b
20.c
21.c

Nitrate-Brucine

22.a
23.c
24.a

Fluoride-SPADNS

25.c
26.a
27.a

Fluoride Distillation

28.b
29.c
30.c

Fluoride-Electrode

31.a
32.c
33.b

Barium

34.b
35.a
36.c

Chlorine

37.
38.
39.

Turbidity

40.b
41.a
42.c

Miscellaneous

43.c
44.a

Pesticide

45.a
46.c
47.c

Herbicides

48.c
49.c
50.b

REGULATIONS

Post-Test Questions

1. In order to use a method not published in the Interim Primary Regulations a person in a State must

   a. have Congressional approval
   b. have State approval
   c. have State and regional approval

SAMPLING

Post-Test Questions

2. The sampling location for the metals and organics should be

   a. in the treatment plant
   b. at a point of entry into the distribution system
   c. at the free flowing outlet of the ultimate consumer

3. The sampling location for turbidity should be

   a. in the treatment plant
   b. at a point of entry into the distribution system
   c. at the free flowing outlet of the ultimate consumer

STATISTICS

Post-Test Questions

4. A statistical measurement for accuracy is

   a. percent recovery
   b. standard deviation
   c. central tendency

QUALITY CONTROL

Post-Test Questions

5. Minimum quality control requires duplicate samples be run by

   a. all laboratories
   b. only large laboratories
   c. laboratories analyzing water supply samples other than its own

SAFETY

Post-Test Questions

6. At least one refrigerator should be of   type for storage of volatile flammable solvents

   a. normal home type
   b. explosion proof
   c. color coded

SILVER

Post-Test Questions

7. The reason for setting a limit on silver is

   a. to be aware of how much revenue could be obtained by removal
   b. because it has been used in the past for disinfection
   c. because of the large amounts found in some supplies

8. In order to test for total silver a _______ must be carried out

   a. colorimetric test
   b. preliminary solubilization procedure
   c. filtration step

9. In order to determine silver at the MCL the sample needs

   a. an extraction procedure
   b. a concentration
   c. no extra step

CADMIUM, CHROMIUM, AND LEAD

Post-Test Questions

10. The oxidation step in the chelation-extraction procedure for cadmium, chromium and lead is to convert the _______ to an extractable form

    a. cadmium
    b. chromium
    c. lead

11. The chelation reagent for the metals that is approved is the

    a. APDC
    b. PDCA
    c. both

12. When aspirating the organic solvent (MIBK)from the APDC extraction the _______ to the atomic absorption burner must be changed

    a. fuel flow
    b. oxidant flow
    c. aspiration rate

MERCURY

Post-Test Questions

13. The heating step in the mercury analysis is to

    a. develop the metallic form of mercury
    b. oxidize the organic forms of mercury
    c. develop the colored forms of mercury

14. The maximum holding time recommended for mercury is

    a. 6 months
    b. 38 days in glass containers
    c. 14 days in plastic or glass containers

15. The mercury analysis includes

    a. a chemical method to produce color
    b. an instrumental procedure
    c. a chemical method to produce the metallic form followed by atomic absorption

ARSENIC AND SELENIUM

Post-Test Questions

16. Arsenic and Selenium are measured by the gaseous hydride method

    a. separately
    b. simultaneously
    c. not

17. The atomic absorption instrument is modified for the gaseous hydride procedure

    a. by removing the burner and inserting an absorption cell
    b. by attaching the sample-argon flow into the burner at the auxiliary air inlet
    c. by not using a hollow cathode lamp

18. The gaseous hydride procedure analyses for forms of Ag and Se

    a. inorganic only
    b. inorganic and organic (after oxidation)
    c. only free

NITRATE

Post-Test Questions

19. The cadmium reduction method determines both nitrate and nitrite. In order to determine nitrate

    a. one analysis is made
    b. the sample is passed through the column and then oxidized
    c. a separate determination must be made for nitrite and nitrate determined by difference

20. After reduction the nitrite in the cadmium reduction procedure is analyzed by

    a. colorimetry
    b. atomic absorption
    c. titrametry

21. EDTA is used in the cadmium reduction method for nitrate to

a. produce the color
b. eliminate the metallic interferences
c. support the flame

NITRATE-BRUCINE

Post-Test Questions

22. Residual chlorine

a. will interfere in the brucine test by bleaching the color
b. will not interfere
c. will interfere by oxidizing the nitrite to nitrate

23. Samples to be run by the brucine method for nitrate should not be preserved with

a. nitric acid
b. sulfuric acid
c. mercuric chloride

24. Sodium chloride is added only to the blank for ____________ samples

a. saline water
b. fresh water
c. colored water

FLUORIDE-SPADNS

Post-Test Questions

25. The SPADNS method obeys Beer's Law to an upper limit of

a. 2.5 mg/lF
b. 1.4 mg/lF
c. 10.0 mg/lF

26. Which interference when allowed to stand will correct itself in the SPADNS procedure

a. sulfate
b. aluminum
c. iron

27. The color developed in the SPADNS test is ____________ proportional to the fluoride concentration

a. inversely
b. directly
c. not

FLUORIDE-DISTILLATION

Post-Test Questions

28. The glass beads are added to the flask to

    a. suppress bumping
    b. provide silica for the F^- to react with
    c. both

29. The distillation procedure distills the F^- over as

    a. NaF
    b. $H_2S.F_6$
    c. HF

30 The distillation procedure is stopped after

    a. the liquid in the distillation flask is about gone
    b. when 180° C is reached
    c. when the solution in the distillation flask turns brown

FLUORIDE-ELECTRODE

Post Test Questions

31 When 25 ml of sample is used for the electrode analysis for fluoride ml of buffer is used

    a. 50
    b. 25
    c. 10

32. When using a specific ion meter the concentration of the sample is obtained from

    a. the meter
    b. the standard curve
    c. the millivolts

33. What element comes closest to interfering with the analysis of fluoride by the electrode

    a. sulfate
    b. Hexametaphosphate
    c. aluminum

BARIUM

Post-Test Questions

34. The preferred oxidant and fuel gases used to determine barium are

    a. air-acetylene
    b. nitrous oxide-acetylene
    c. argon-hydrogen

35. If the air-acetylene flame is used, the interferences are overcome by adding

- a. EDTA
- b. Lanthanum
- c. Nitrogen

36. If the nitrous oxide-acetylene flame is used, the interference is suppressed by adding potassium

- a. chemical
- b. color
- c. ionization

CHLORINE

Post-Test Questions

37. The chlorine sample is to be analyzed by

- a. an approved laboratory
- b. anyone acceptable to the authority
- c. the State itself

38. The chlorine analysis must be performed for chlorine

- a. total
- b. combined
- c. free

39. The chlorine samples must be taken

- a. in the plant
- b. at the entrance to the distribution system
- c. at points representative of the conditions within the distribution system

TURBIDITY

Post-Test Questions

40. The method for analyzing turbidity is based on

- a. transmission of light
- b. absorption of light
- c. nephelometry

41. Analysis for turbidity must be carried out by

- a. anyone acceptable by the State or regional authority
- b. by laboratory approved by the State or regional authority
- c. the State or regional authority

42. The method for standardization of the analytical instrument used to measure turbidity is

- a. Fullers earth
- b. the manufacturer's standard
- c. Formazine

MISCELLANEOUS

Post-Test Questions

43. The Interim Primary Drinking Water Regulations contain provisions for

    a. public notification for failure to comply with the Regulations
    b. siting requirements for future plant sites
    c. both of the above

44. The proposed Secondary Drinking Water Regulations will

    a. become enforceable when effective
    b. not be enforceable when effective
    c. will not be issued

PESTICIDE

Post-Test Questions

45. The pesticide sample is preserved by

    a. sulfuric acid
    b. hexane
    c. refrigeration at 4° C

46. The detector used to measure the pesticides is the

    a. flame ionization detector
    b. the electron capture detector
    c. the ultra violet detector

47. Which of the following has more than one peak which must be quantitated

    a. Aldrin
    b. Lindane
    c. Toxaphene

HERBICIDES

Post-Test Questions

48. The chlorophenoxy herbicides are analyzed as their form

    a. acid
    b. ester
    c. salts

49. The detector used to measure the herbicides is the

    a. electron capture detector
    b. electrolytic conductivity detector
    c. flame ionization detector

50. Many of the chlorinated insecticides are eliminated as interferences by the

a. extraction step
b. esterification step
c. hydrolysis step

IMPLEMENTATION

Post-Test Questions

1. A laboratory must have an on-site evaluation

   a. once a year
   b. once every two years
   c. once every three years

2. A laboratory must be certified for

   a. all parameters included in the bacteriological, chemical and radiological lists
   b. only those parameters the laboratory wishes to perform
   c. all parameters in the chemical and bacteriological but not radiological

3. Preliminary certification may be awarded

   a. at any time
   b. until a certification can be made
   c. only until a program has been certified to conduct on-site evaluations of laboratories

4. A state must have a

   a. program to evaluate "local" laboratories
   b. program to evaluate "local" laboratories even if the State performs all analysis in its principal laboratory
   c. program to evaluate "local" laboratories only if all analysis are not to be performed in its principal laboratory

5. A certification team should include

   a. a chemist, microbiologist, and radiochemist
   b. a microbiologist, engineer and radiochemist
   c. a microbiologist, engineer, chemist and radiochemist

PLANNING A CERTIFICATION

Post-Test Questions

6. The certification officer should

   a. just drop in for his evaluation
   b. schedule the next certification during the current evaluation
   c. call the lab and schedule the visit

7. As a guide to assist laboratory certification teams the time estimate for a laboratory evaluation is

   a. one day
   b. one week
   c. two weeks

8. The check sheets provided are to be

   a. used as a guide
   b. strictly adhered to
   c. ignored

9. The certification officer must be knowledgeable of analytical techniques because he/she will

   a. evaluate them during his/her visit
   b. be expected to run them
   c. offer technical assistance if the need arises

10. Uranium is measured by

   a. direct counting techniques
   b. its fluorescence
   c. by precipitation and counting

11. A laboratory can   for use in analysis

   a. apply for approval for an alternative method
   b. never use any method other than those in the Federal Register
   c. use any method desired

12. A laboratory must   listed in the Federal Register

   a. be certified for all contaminants
   b. apply for certification on only those contaminants they desire that are
   c. need not be certified for any contaminants

13. Residual chlorine and turbidity

   a. are preserved and sent to a laboratory for analysis
   b. are run at the analysts convenience at the treatment plant
   c. are run immediately at the sampling location

14. The approved test method for residual chlorine is the

   a. amperometric titrator
   b. DPD colorimetric method
   c. the iodometric method

SAMPLING

Post-Test Questions

15. Where must the samples (except turbidity) be taken

   a. at the treatment plant
   b. at the point of entry to the distribution system
   c. at the free flowing outlet of the ultimate user

16. Where must the turbidity sample be taken

    a. at the treatment plant
    b. at the point of entry
    c. at the free flowing outlet of the ultimate user

17. What method of preservation should be used for organics

    a. nitric acid
    b. sulfuric acid
    c. refrigeration (to about 4° C)

18. Who may take a sample as specified by Federal Regulations

    a. only those persons having the specialized training
    b. only water supply authority personnel
    c. anyone

19. If properly preserved, how long may the pesticides be held in the laboratory

    a. 14 days
    b. 7 days
    c. 14 days - shipping time

20. When evaluating the laboratory the Certification Officer

    a. suggests the need for compliance with the personnel criteria
    b. cannot approve the laboratory if the personnel criteria is not met
    c. insists on the compliance with the personnel criteria

21. Those persons currently doing chemical analysis to be approved

    a. are advised to receive minimum of 2 weeks additional training in water chemistry
    b. must acquire all the suggested personnel criteria
    c. are requested to obtain a college degree in order

22. Each year of college-level training in a related scientific field is

    a. equal to three years of work experience
    b. equal to two years of work experience
    c. equal to one year of work experience

GENERAL PRACTICES

Post-Test Questions

23. An analytical balance in order to comply with chemical guidelines

    a. must be serviced once a year
    b. must only be calibrated by class S weights
    c. must have a service contract and class S weights available to calibrate

24. Volumetric glassware should be

    a. class A
    b. class B
    c. class C

25. Water to be used in analytical tests must

    a. be completely analyzed
    b. have 0.5 to 2.0 megohms of resistance at 25° C
    c. be distilled

26. The legal reference edition of Standard Methods is

    a. 13th
    b. 14th
    c. always the latest

27. Kit standards need calibration

    a. yearly
    b. never
    c. every 6 months

PRE AND POST-CONFERENCES

Post-Test Questions

28. According to the Criteria Document's Operational Guidance Section one of its concluding discussions of the Post-Test should be concerned with

    a. how the authority can aid the laboratory
    b. personnel background
    c. evaluation of the procedures used in the laboratory

29. The sampling compliance should be determined by

    a. questioning the laboratory director
    b. questioning the laboratory director and review of records
    c. review of records

30. Discussion of the laboratory evaluation should concern

    a. only the laboratory director
    b. only the laboratory director and cheif chemist
    c. the laboratory director, chief chemist and persons carrying out the analysis

RECORDS AND REPORTS

Post-Test Questions

31 The data to be retained should include

    a. raw data, calculations, quality control and reports
    b. results
    c. all of the above

32. The region or state should have   for turbidity and residual chlorine analysis

a. a plan for approval
b. the results run in their laboratory
c. both of the above

33. All data reporting is

a. mandatory
b. guideline
c. some of both

BASIC STATISTICS

Post-Test Questions

34. Accuracy is the tendency of an analysis to

a. give values close to the true value
b. agree among results of repeated measurement on a single sample
c. not give any instrumental error

35. Precision is the tendency of an analysis to

a. give values close to the true value
b. agree among results of repeated measurements on a single sample
c. not give any instrumental error

36. It   possible to have precision without accuracy

a. is
b. is not
c. is and is not

QUALITY CONTROL

Post-Test Questions

37. The check of the standard curve must consist of

a. a standard at mid-range of the curve
b. a high and low standard
c. all points on the curve

38. All laboratories to be certified must analyze an unknown performance sample

a. once a quarter
b. once a year
c. twice a year

39. A laboratory analyzing water supply samples other than its own is suggested to

a. calculate standard deviations for all measurements being conducted
b. analyze an unknown performance sample twice a year
c. collect all the samples

PREPARATION OF A REPORT

Post-Test Questions

40. Should a narrative report be written

    a. yes
    b. no

41. What are the levels of certification

    a. certified and non-certified
    b. provisionally, certified and non-certified
    c. provisionally and non-certified

42. How often should the report be written

    a. every three years
    b. every six years
    c. after each evaluation

EQUIPMENT NEEDS

Post-Test Questions

43. There are needs for equipment listed in the Criteria and Procedure Document

    a. guideline
    b. mandatory
    c. guideline and mandatory

44. A laboratory would need instrument for fluoride determinations

    a. both a pH meter and a specific ion meter
    b. a specific ion meter and a spectrophotometer
    c. a specific ion meter or an expanded scale pH meter or a spectrophotometer

45. Furnace techniques for use with atomic absorption can be considered as

    a. a guideline
    b. mandatory
    c. an alternative analytical technique

46. A recorder for use with a gas chromatograph can be considered as

    a. a guideline
    b. mandatory
    c. not necessary

47. The gas chromatograph must be equipped with detector

    a. a flame ionization
    b. a thermal conductivity
    c. an electron capture

LABORATORY SAFETY

Post-Test Questions

48. Laboratory Safety Certification

    a. must be withheld for safety violations
    b. must not be withheld for safety violations
    c. may be withheld for gross safety violations

49. Every laboratory is suggested to have at least one

    a. smoke alarm
    b. hood
    c. sprinkler system

50. should be placed throughout the laboratory

    a. fire extinguishers
    b. fire hoses
    c. buckets of sand

51. Safety is in laboratory certification

    a. a mandatory item
    b. a guideline
    c. both mandatory and guideline items

KEY FOR POST-TEST

Regulations

1.a

Sampling

2.c
3.b

Statistics

4.a

Quality Control
5.c

Safety

6.b

Silver

7.b
8.b
9.c

Cadmium, Chromium, and Lead
10.b
11.c
12.a

Mercury

13.b
14.b
15.c

Arsenic and Selenium

16.a
17.b
18.b

Nitrate
15.c
20.a
21.b

Nitrate-Brucine

22.a
23.a
24.a

Fluoride-SPADNS

25.b
26.b
27.a

Fluoride Distillation

28.b
29.b
30.b

Fluoride Electrode

31.b
32.a
33.c

Barium

34.b
35.b
36.c

Chlorine

27.b
38.c
39.c

Turbidity

40.c
41.a
42.c

Miscellaneous

43.c
44.b

Pesticide

45.c
46.b
47.c

Herbicide

48.b
49.a or b
50.c

KEY FOR POST-TEST

Implementation

1.c
2.a
3.c
4.c
5.c

Planning a Laboratory Certification

6.c
7.b
8.a

Analytical Methodology

9.c
10.b
11.a
12.b
13.c
14.b

Sample Collecting Handling Preservation

15.c
16.c
17.c
18.c
19.a

Personnel

20.a
21.a
22.c

General Laboratory Practices

23.c
24.a
25.b
26.a
27.c

Pre and Post-Conferences

28.a
29.b
30.c

Records and Reports

31.c
32.a
33.b

Basic Statistics

34.a
35.b
36.a

Quality Control

37.a
38.b
39.a

Preparing a Report

40.a
41.b
42.c

Instrument and Equipment Needs

43.c
44.c
45.c
46.b
47.c

Safety

48.b
49.b
50.a
51.a

METHOD FOR THE DETERMINATION OF CHEMICAL CONTAMINANTS IN DRINKING WATER

Instructor Feedback Report

Lesson Title ____

Date __________ Time __________ Instructor ______________________

Note to the Instructor: This worksheet and the questions are presented as a guide, to assist you in giving your impressions of your contribution to the conduct and outcome of this course. While your report may reflect information gotten from other measurement tools, it should capture important subjective and observational information that other elements of the course evaluation will miss. Please feel free to amplify your responses to the questions with any other observations you may wish to offer.

The Participants

1. Did they become involved in the subject? (Did they ask questions, or offer observations based on their own knowledge or experience? What was your impression of the attitude of the class?)

2. What was the student reaction to the lesson material presented in the Student Manual?

The Lesson

1. Did this subject appear to be something which needed to be in the course?

2. What was not covered that should have been?

3. What portions of the lesson might as well have been omitted?

4. Was there any evidence of repetition, or conflict, in this lesson as compared with any other lessons in the course?

Instructional Techniques

1. Were the instructional techniques appropriate to the background (training and experience) of the participants?

2. Were the instructional techniques and methods appropriate to the subjective matter and training objectives of the lesson? Explain any deficiencies noted.

3. What, if any, changes in the instructional procedures would you suggest to the course designers?